The Origins *of the* Lost Fleet *of the* Mongol Empire

RANDALL J. SASAKI

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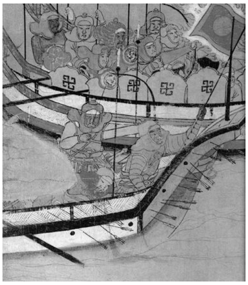

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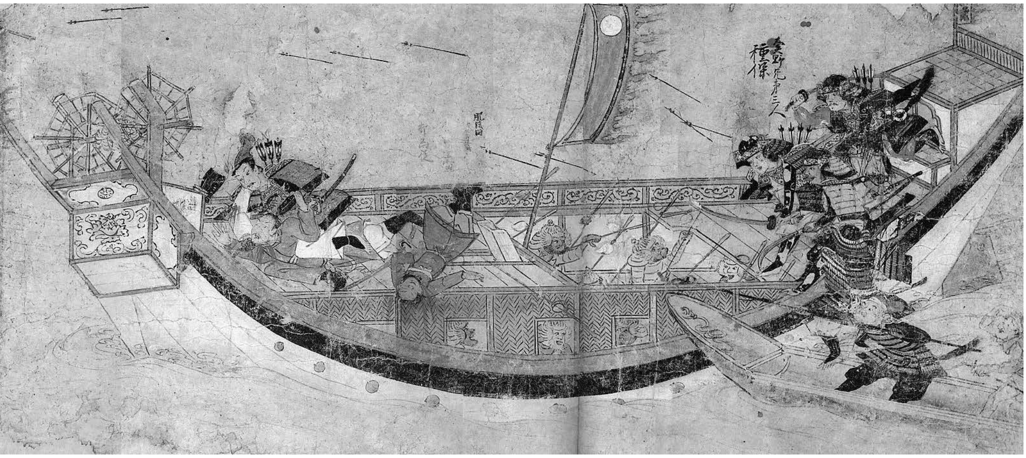

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Preface

THE STORY OF *Kamikaze* plays an important role in the history and society of Japan. The "original" *Kamikaze*, or divine wind, took place in the late thirteenth century CE. This was the time when the Mongols became the dominant force in East Asia, conquering vast territories and creating the largest empire in the world. After subjugating the peninsula country of Korea, Khubilai Khan, the emperor of the Mongols, decided to invade Japan. Khubilai sent naval forces across the Tsushima Straits in 1274 CE with nine hundred ships. Historical documents suggest that a fierce battle took place near Hakata in northern Kyūshū; however, the Mongols retreated after a few days of fighting, burning the city and damaging the prosperous center of international trade. Perhaps this was more of a raid in nature.

At the time, Khubilai had not completed the conquest of China, but soon after this invasion of Japan, he decided to finish the Chinese; this was the first time in history that the "barbarians" from the northern steppes conquered all of China. The task of conquering the great maritime empire of the Southern Song dynasty (1127–1279 CE) was a watershed event in the history of East Asia. After receiving "the mandate of heaven" and becoming the unified ruler of the Yuan dynasty (1271–1368 CE) of China, Khubilai once again set his eyes on invading the island nation of Japan. In 1281 CE he sent a massive fleet of more than 4,400 vessels from both China and Korea to conquer the land ruled by samurai. The fate of Japan as an independent nation was about to be decided. When the massive fleet was gathered in Imari Bay in western Japan, near the island of Takashima (fig. 1), a powerful typhoon struck the fleet and crushed the ships into pieces. Historical documents from China, Korea, and Japan all agree that most of the fleet, perhaps as many as 90 percent of the ships, was

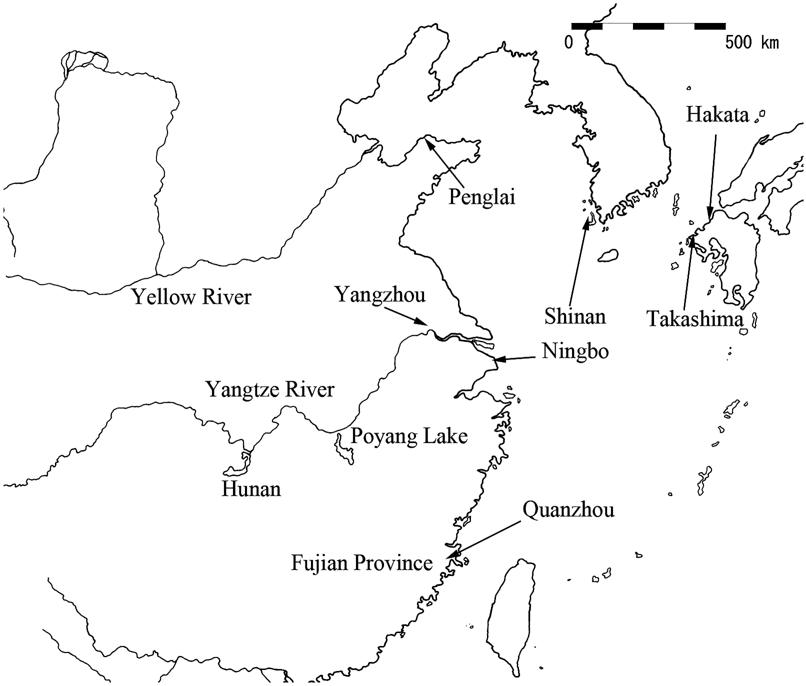

FIGURE 1. Map of East Asia.

lost.[1] Khubilai's dream of becoming the one and only ruler in East Asia perished with the legendary storm that Japanese called *Kamikaze*, a divine wind that protected the nation.

Over time, the legend of divine wind was not forgotten, but the detailed story of the event was lost. People remembered the terror that the Mongols had caused, but no one ever thought about systematically studying the event or collecting historical documents. Once the study of history and archaeology began to be emphasized in the modern era, a new epoch of research commenced. Historians examined original documents and iconographies from China, Korea, and Japan to reveal the secrets of the event. Perhaps the most useful evidence for the study of the Mongol invasions of Japan has been *Mōko Shūrai Ekotoba*, a contemporary scroll painting, skillfully drawn to illustrate the fighting deed of a young samurai, Takezaki Suenaga, to impress the shogun (fig. 2). Although the ships are drawn in detail, it is not certain if the features are depicted accurately, and there are still more questions than answers. How powerful was the storm, and were there any human errors involved in this catastrophic event? Is the number of ships reported in historical documents correct, and how many vessels were lost during the storm? Numerous questions were asked, and many scholarly articles and books were written about the subject, detailing the events as well as listing possible cause of failures.[2] Despite much effort and a few great accomplishments, the real story of the invasion could not be known without recovering the actual remains. People dreamed of finding a vessel filled with artifacts from the invasion that was obliterated by the storm, but it remained a dream for many.

The dream of finding vessels from the invasion became a reality when Japanese underwater archaeologists began to uncover pieces of artifacts and remains of hulls from the island of Takashima beginning in the early 1980s. The Takashima underwater site in Nagasaki prefecture has produced a large collection of artifacts related to the invasion, and archaeologists have analyzed these remains and published the results.[3] This site has the potential of finally shedding light on the mysteries surrounding the historical event that changed the course of

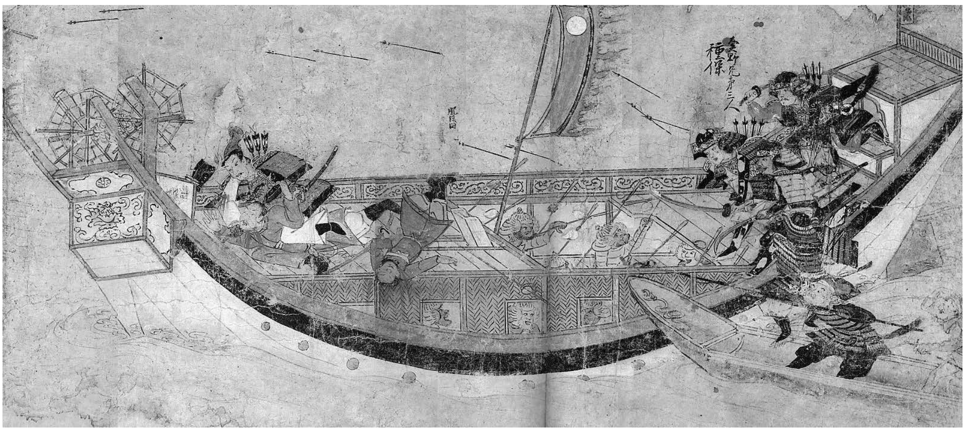

FIGURE 2. Chinese ship being attacked by Japanese samurais as depicted on the *Mōko Shūrai Ekotoba* scroll. Courtesy of the Japanese Imperial House Museum.

the nation. Unfortunately, the successful research of this archaeological site has been largely ignored by western scholars because most of the publications have not been translated into English. One exceptional book was written by James P. Delgado, titled *Khubilai Khan's Lost Fleet: In Search of a Legendary Armada*.[4] This book tells the story of the discovery and significance of the archaeological finds. Delgado, a world-renowned maritime archaeologist, is not a specialist in traditional East Asian shipbuilding technologies, and thus the book only touches the surface of what the remains of ships might reveal. The book that you are now holding in your hand is about the detailed account of the discovery and analysis of the actual remains of timbers from the shipwrecks found beneath the waves. As you will read, in the hands of a trained archaeologist the physical remains of the vessels can reveal a story.

In the fall of 2011 the discovery of an intact vessel from the second Mongol invasion from the Takashima underwater site was announced to the international media. This discovery, made by the team from Ryūkū University led by Yoshifumi Ikeda, was what people had been waiting to see for thirty years since the search for sunken vessels began at Takashima. Later, the Japanese Agency for Cultural Affairs announced that the Takashima underwater site will be designated a National Historic Site. This was the first time in the country that an underwater archaeological site has been awarded such status—the highest rank given to historic monuments and archaeological sites. These news reports often omit the fact that archaeologists must spend years or even decades analyzing artifacts before making any sense of the discovery.

After a preliminary recording of the site was made, the hull was covered to allow research in the future. Excavating a hull underwater requires a large sum of money, and once artifacts are raised, all items must be conserved before being made available for the public. The research team and the local government at Takashima did not have the means to pay for all of this. In 2014 a decision was reached that this hull would not be raised but kept underwater, with a program of monitoring in place. Archaeologists record temperature fluctuation, pH level, dissolved oxygen, and other parameters that may have a detrimental effect on the preservation of the site. Based on these recordings, archaeologists determine the most efficient method to preserve the site in situ.

It appears that the ship did not carry much cargo; only a handful of ceramics jars and bricks—which may have been used as ballast—was found. Two possible scenarios can be drawn from this. First, the vessel was not carrying cargo; it was a landing craft. Second, the ship was carrying cargo, but all had been lost during the storm and subsequent depositional events. The hull was built in China, using iron nails and constructed with bulkheads—characteristic of a Chinese vessel. (However, no bulkheads were found in place; only impressions and nails indicating their locations were found. Bulkheads most likely had been removed through natural processes.) The original overall length of the ship may have exceeded 20 meters, but without cargo and without a detailed analysis of the hull itself, we cannot make any further comments. Japanese archaeologists may decide to raise this hull in the future, and if that happens, a great story will surely be told.

The decision not to raise the hull, I believe, was the right decision to make. Although we may not know the details of the hull, the time and money can be spent to search for a hull that may be better preserved, full of artifacts that reveal the mysteries of the Mongol invasions. The hull we have now is indeed one of the greatest archaeological discoveries in the nation; however, it also proves that something better may be found one day, and the resources must be allocated for that purpose. Fortunately, prior to this recent find, many great discoveries had been made, including the large complete anchors and a large collection of hull remains, weapons, and other personal items related to the second Mongol invasion. You do not have to wait to know more about these significant finds because the most up-to-date account of the important discoveries made at the Takashima underwater site prior to 2011 will be presented here.

The main theme of this book is to reveal the naval organization of the second Mongol invasion of Japan through the analysis of timber remains of hulls discovered at the Takashima underwater site. The naval organization includes what kinds of ships were brought to Japan, where they were built, how the ships were constructed, and what the strategy was behind the invasion plan. These questions are continuously asked throughout the book, which is organized into ten chapters. In the first chapter I will describe the history of research at the Takashima underwater site and the story of how I got involved with the project. Perhaps this chapter is the most personal account within the book. The historical background of East Asia and the invasion will be described in chapter 2. The naval organization at the time, as well as typical ships of East Asia, reconstructed with archaeological and historical records, will be illustrated in the following chapter. In chapter 4 a brief description and analysis of artifacts other than hull timbers will be given. The next chapter, which is the most technical section in this book, discusses the methodology I used to categorize the timber remains. Each and every timber was assigned to a category based on the component within the hull, including planks, bulkheads, and beams. In the next three chapters, I explain other analytical methods employed for the study of the hull remains including descriptive and detailed study of some of the selected timbers, wood species identification, and joinery analysis.

The last chapter before the conclusion deals with questions people have repeatedly asked. Answers to a few of those questions have been revealed through this research including the two most important: what was the state of Japanese defense, and were the invading vessels hastily constructed to meet the demands imposed by Khubilai Khan? Although many research questions remain unanswered due to the nature of the site, the timber remains provide fresh insights into how the Mongols organized the naval forces and what types of vessels they brought to Japan. These questions could not be answered without the dedicated work by Japanese maritime archaeologists and their efforts to bring this important archaeological site to the world's attention.

The Origins *of the* Lost Fleet *of the* Mongol Empire

Chapter 1 How the Story Starts

BEFORE DISCUSSING the details of my research—which is the analysis of the remains of hull timbers from the second Mongol invasion of Japan in 1281 CE, discovered at the Takashima underwater site—it is imperative to describe the site itself, how I got involved with the project, and the methods I used for my study at Takashima. Without this information, the simple descriptions of results may appear insignificant. In other words, this chapter gives an overall meaning to my research by providing some background to the discoveries and my personal account of how everything started.

The History of Research at Takashima

From historical documents, the island of Takashima in Imari Bay in western Japan was known as the place where the Mongolian fleet from the second invasion met its end (fig. 3). It was not until the 1970s, however, that Nenko Koga, a local historian, first voiced the possibility of finding the lost Mongolian fleet underwater along the shores of Takashima.[1] He studied the *Genko*, or the Mongol invasion, for many years and realized that the quickest way to know more about the battle and the ships was to find their remains and study them by observing and analyzing directly. He noted that fishermen from Takashima Island often found Chinese ceramic pots and also that there was an unconfirmed account of a sword snagged in their nets.[2] Furthermore, a copper statue of *Amitabha Tathagata* (sitting Buddha), made in a style found in the Goryeo dynasty (918–1392 CE) of Korea, was raised from the sea in the late nineteenth

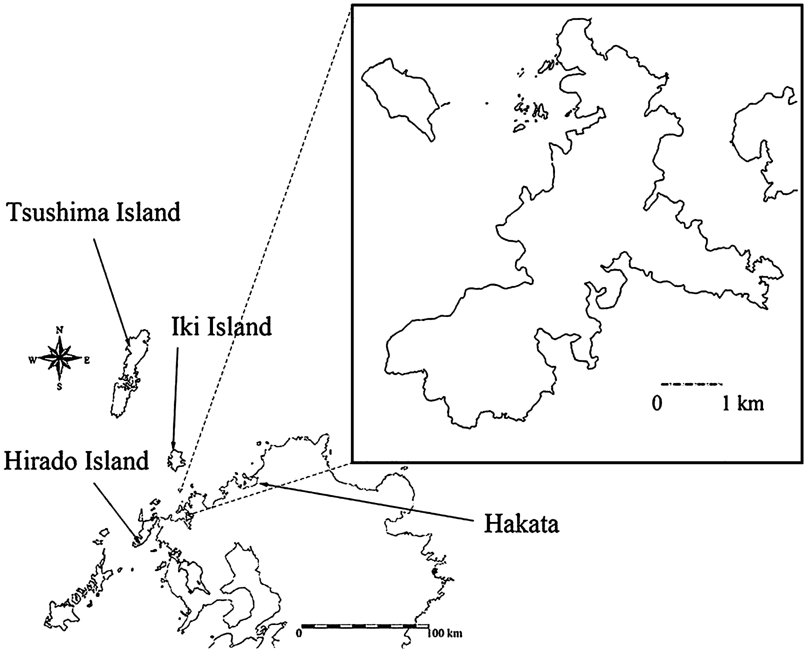

FIGURE 3. Map of Kyūsyū region and Takashima.

century. This statue is about 77 cm in height and is currently enshrined at a temple in Takashima. Considering these accounts, Koga believed that the potential of finding an actual vessel was high, and he proposed that underwater investigations of the bay be conducted. Although the study of maritime archaeology was gaining momentum in the western world at this time, no archaeologists in Japan had imagined themselves diving and conducting excavation underwater. Many Japanese archaeologists thought that it was impossible to find artifacts from a naval battle that took place over seven hundred years ago and that any effort to search for ephemeral remains would be a waste of resources. It was Torao Mozai, a marine engineer, who answered the call.[3]

The legacy of Mozai is a key to understanding the later development of maritime archaeology in Japan. In the early 1980s Mozai and his team began the search for the sunken fleet in Imari Bay using a color sonar system that he developed.[4] This system used ultrasonic waves that enabled large objects buried beneath the ocean floor to be seen. It is a unique system compared with the more common side-scan sonar system used today on many underwater archaeological surveys to find a shipwreck. One drawback of this system was the low resolution of the image; many "anomalies" or "possible buried features" were found, but the images produced were not clear enough to "see" what they were. The only way to identify the "anomalies" was to excavate. Hired divers were sent down to the areas with these features in hopes of finding a shipwreck or two. Against all odds, divers who were sent to investigate the anomalies brought up many artifacts, including storage jars from China, stone anchor stocks, and bricks; these artifacts were most likely related to the Mongol invasion.

The news of the discovery of the possible Mongolian fleet spread quickly. Soon after the public announcement, a local fisherman presented a bronze square seal to Mozai's research team. He had found this seal several years earlier when he was collecting seashells in Takashima's Kōzaki Harbor. The seal was engraved with a script he had never seen before, and not knowing the significance of the find, he kept the item in his tackle box (fig. 4). After hearing the news of the discovery of artifacts related to the *Genko*, he remembered the seal he had found before and decided to show the artifact to the survey team. The seal, including the handle, was 4.4 cm high and weighed

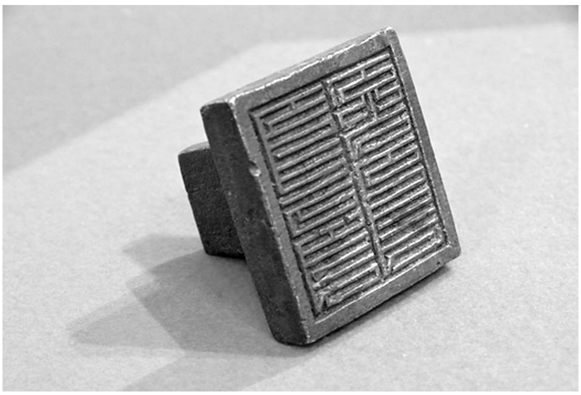

FIGURE 4. Bronze seal discovered at Takashima. Courtesy of Matsuura Board of Education, photo by author.

726 g. The seal itself was 6.6 cm square and 1.5 cm thick. The unknown engraving was identified as Phags-pa script, the official Mongolian script used in a Chinese court.[5] Along with the Phags-pa script, a translation in Chinese was engraved on its side that read "*guan jun zong ba yin*" (官軍総把印: a seal of commander/officer). The seal was also engraved with a date of 1277 CE. The seal was most likely given to a certain commander in Khubilai's army before the invasion; perhaps the seal was given to the commander by none other than the Khan himself. Simply put, there is no better evidence for the fact that the battle took place here in Takashima—this was the smoking gun that gave the definite proof that the invading forces were here.

The survey was well publicized not only in Japan but all over the world. The announcement that "the lost fleet of the Mongol Empire was discovered in Japan" became an international sensation.[6] However, this breakthrough was not without a blemish. Mozai did not discover a shipwreck, but numerous isolated artifacts most likely related to the invasion; not all artifacts were conclusively from the invasion. To make the discovery controversial, Mozai had little understanding of archaeological research. He raised these artifacts without recording their provenience, donated some to the local museum, and even distributed the rest to the local community. Recording provenience of all artifacts is fundamental to the study of archaeology. For this reason, the survey was viewed by many Japanese archaeologists as not being real scientific archaeology but merely a salvage operation without a scholarly merit. Nonetheless, Mozai's project showed great potential for further investigations. Mozai not only put the location of the "lost fleet" on the map, but he was successful in convincing the government to designate the shoreline of Takashima as a protected archaeological site. The registered area covers 7.5 km of the southern coast of Takashima, extending from the shore 200 m out to the sea. In Japanese law, once a site is registered, a survey and excavation are required prior to any development that may take place.[7] It was also decided that the site would be managed by the Takashima Board of Education for all future projects.[8] In other words, Mozai had laid the foundation upon which to build a great archaeological project in the future.

In 1984 construction of a harbor in the Tokonami area near the southern tip of Takashima was proposed. Because the proposed project was within the zone of Mozai's designated protected site, a survey and excavation followed. The project was organized by the Takashima Board of Education and included experts from many fields of study. From the previous survey, it was known that silt had accumulated up to 3 m above the layer that contained artifacts from the Mongol invasion. Heavy equipment was used to remove the silt overburden. A small amount of modern debris was mixed among the archaeological finds, indicating that some objects lost in the sea tended to migrate through the silt.[9] This project at Tokonami Harbor also produced artifacts related to the invasion, but no substantial remains of a hull were found. Several small-scale excavations followed intermittently for the next decade. There was no such field of study as underwater archaeology in Japan at the time, and no clear guidelines for conducting research, excavating underwater, or conserving artifacts existed. Despite the lack of clear direction, a new leader emerged. Kenzō Hayashida, who studied classical archaeology at the University of Pennsylvania, assembled a group of archaeologists and created the Kyūshū Okinawa Society for Underwater Archeology (KOSUWA). Although it began as a small group, its membership increased and it became the county's authority in maritime archaeology. The archaeology that Hayashida and KOSUWA promoted was scientifically as meticulous as "land" archaeology can be; the results of the excavation proved to a larger archaeological community in Japan that excavation could be conducted underwater. Despite reaching a wider audience, as with Mozai, Hayashida and his team did not "hit the jackpot." Some artifacts discovered at Takashima included stone anchor stocks, storage jars known as *shijiko* (四耳壺: a jar with four lugs), and small fragments of wood. They were clearly artifacts from the invasion, but they were not groundbreaking discoveries that were able to convince the government officials and universities to support the further surveys and excavations.

In 1994 a major harbor renovation at Kōzaki Harbor was proposed. Kōzaki Harbor is where the bronze seal mentioned above was discovered. Hayashida realized that this area had to be a key in finding a shipwreck. The north shore of Takashima is rocky, and the prevalent Tsushima current makes the area unfavorable for navigation and safe anchorage. The south side of Takashima, however, has slow currents and moderate waves. Even today, when a typhoon comes near the Kyūshū region, many ships find safe harbor in this well-protected bay. It may be assumed that Khubilai's fleet sought a safe harbor inside the protected bay when the *Kamikaze* struck. The Kōzaki area had the highest concentration of recovered artifacts related to the invasion, and in fact, one can collect a handful of broken ceramics just by walking along the shore during a low tide. Kōzaki Harbor is, in all probability, situated directly facing the area where the Mongol fleet was riding at anchor during the fateful typhoon. The survey of Kōzaki Harbor was organized by KOSUWA and supported by the Takashima Board of Education. A sub-bottom profiler, which is commonly used for identifying buried geographical features, was used to locate possible shipwrecks and learn more about the sedimentation of the bay. This survey equipment lets one see a profile of buried seafloor. Hayashida identified four anomalies, and following this, heavy equipment was used to remove the overlying silt deposit. Several artifacts relating to the Mongol invasion, including bricks and storage jars from southern China, were found during the process. Expecting a major discovery, Hayashida and his team laid a large grid system over the entire area, and archaeologists trained as divers were sent to carefully excavate each square.[10]

Hayashida's expectations fully blossomed. Approximately 100 m offshore, large objects began to emerge from the thick layer of silt. Soon the identities of the large objects were revealed by carefully excavating around the artifacts. Four wooden anchors fitted with stone stocks were found all aligned in the same direction toward the shore (fig. 5).[11] It is not common to find an anchor still stuck inside the mud, as if it were used recently; this is the first time in Japan that a wooden anchor, with all parts, was found in an archaeological context. Furthermore, some of the anchor cables were found stretching straight from the anchors toward the shore. Hayashida realized that these anchors were the most significant finds yet seen at the Takashima underwater site. This was clearly a sign of an undisturbed layer,

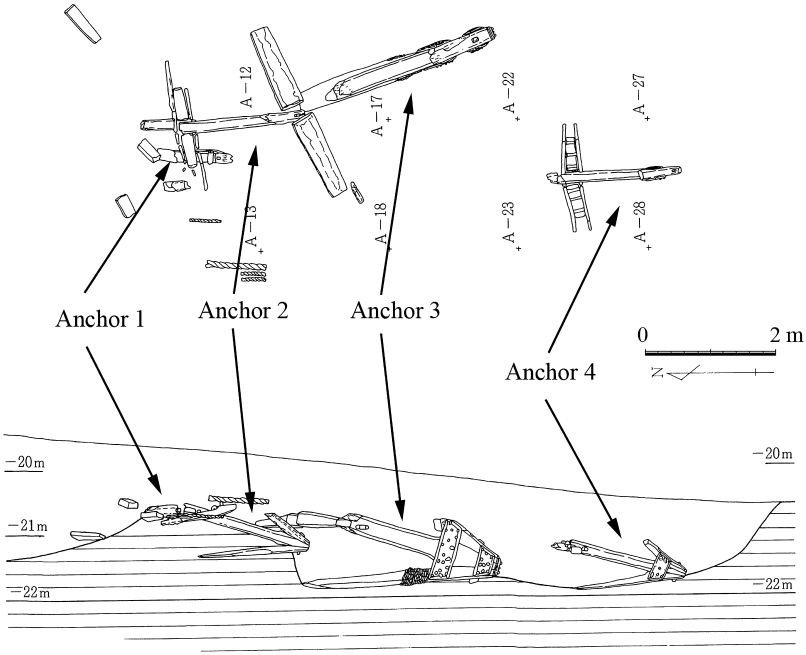

FIGURE 5. Drawing of four anchors in situ (after Takashima Board of Education 1996, fig. 13).

where anchors were set during the legendary storm to prevent the ships from striking against the shore. The layout of the anchors and the cables indicated that the wind was blowing from the south, which corresponds well with the direction of the approaching typhoon. All four anchors were of different sizes, suggesting a possibility of multiple ships present at the time.

The discovery of the anchors generated new interest among the public as well as archaeologists in Japan. A new multiyear excavation was planned at Kōzaki Harbor beginning in 2000. The following seasons of excavations were a new phase of development at Takashima because the project was partly funded by the national government to continue the search for the sunken remains of the invasion fleet. In 2000 and the following two seasons, an area of approximately 950 m^2, or about 30 by 35 m, was excavated. Again, a great discovery was made; a large portion of hull remains was identified along with

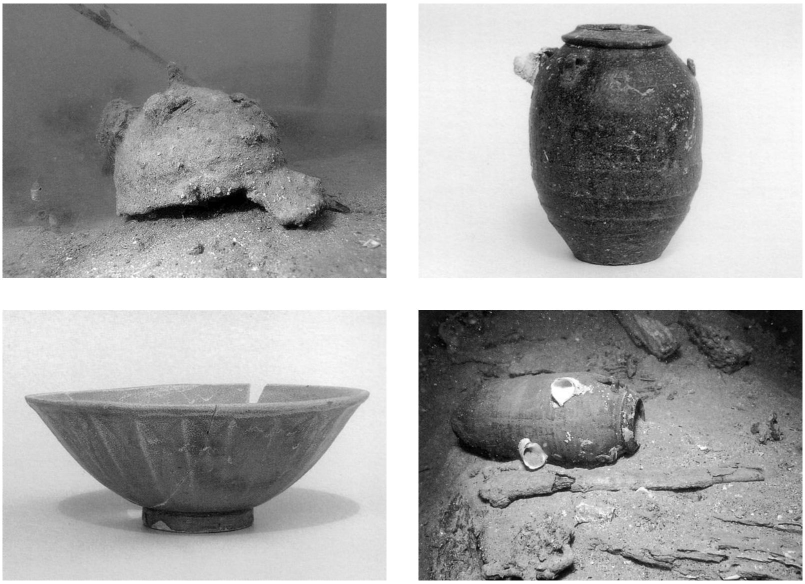

FIGURE 6. Example of artifacts raised from Takashima: *a*, iron helmet (from Takashima Board of Education 2003, plate 13–5); *b, shijiko* jar (from Takashima Board of Education 2003, plate 23–1); *c*, porcelain bowl (from Takashima Board of Education 2003, plate 17–1); *d, shijiko* and iron sword (from Takashima Board of Education 2002, plate 60). Reprinted with permission.

more than 2,000 artifacts (fig. 6). After two decades from the initial survey at Takashima conducted by Mozai, substantial remains of a hull were revealed for the first time. Along with bulkhead planks of about 6 m in length, a possible mast step, large hull planks, and other large and small timbers were found. Various artifacts ranging from weapons and armor, human and animal bones, and personal items were found. The discovery is considered one of the greatest maritime archaeological discoveries not only in Japan but also in the region, or perhaps even in the world. Only a handful of shipwrecks have been discovered in East Asia, and the study of Asian historical watercraft is far from being a central focus of archaeologists in the region. One of the unique characteristics of Takashima is that it is possible to find various types of vessels from all over Asia. It is said that thousands of ships were buried at the site; these vessels were constructed in either Japan, Korea, or all over China. In other words, a researcher does not have to travel to all those locations to study the ships; those ships came to Japan and were lost (until the recent discovery). In theory, a comprehensive analysis of all types of East Asian watercraft can be conducted just by analyzing a single site. The potential of such a site is highly significant.

Besides the hull remains, one of the most significant artifacts discovered was *tetsuhau* (てつはう: iron bomb),[12] the earliest ordnance ever used in a naval engagement (fig. 7). As mentioned above, many artifacts related to the battle were found, including swords, arrows, and helmets.[13] Shipboard items necessary for the voyage and the military expedition, such as storage jars, ceramic bowls, and bricks (used for ovens on board) were also found. The list of personal items discovered is not short; coins, lacquerware, religious objects, combs, and various miscellaneous objects. Each of the artifacts tells a story; to do so, however, artifacts must be conserved, analyzed, and the results published in detail. This process takes time, sometimes up to a decade or two, and the story is slowly coming out now.

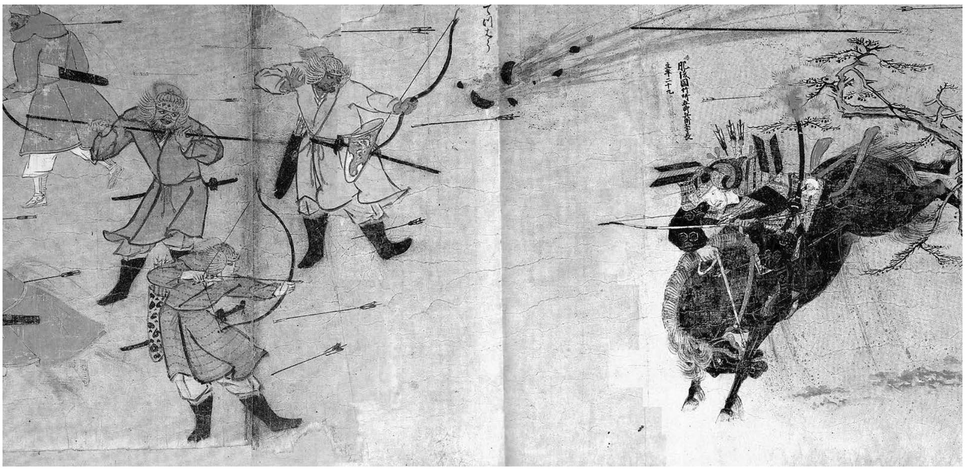

FIGURE 7. Battle scene showing exploding *tetsuhau* as depicted on the *Mōko Shūrai Ekotoba* scroll. Courtesy of the Japanese Imperial House Museum.

Further excavations were organized to explore the Kōzaki Harbor area. Although smaller areas were excavated compared with those of the previous seasons, a large number of artifacts were discovered.[14] KOSUWA, now with increased membership, became the Asian Research Institute for Underwater Archaeology (ARIUA) and continued the search for sunken remains at Takashima as well as at other underwater archaeological sites along Japanese coasts.

Joining the Great Discovery

The research at Takashima began to be noticed in the western literature again in the first decade of the twenty-first century when Delgado, as a host of the National Geographic International Television series *The Sea Hunters*, visited Takashima in hopes of bringing the story of the *Genko* and the research at Takashima to a broader audience. When I was first introduced to the discoveries made at the Takashima underwater site, I was just starting my first year of graduate studies at the Nautical Archaeology Program at Texas A&M University. The program was founded by Dr. George Bass, who conducted the first archaeological excavation underwater using the exact same standards set for an excavation on land. He initiated the graduate program for training nautical archaeologists in 1976. Twenty-five years later, in 2002, he was retiring when I was beginning my career. Delgado was one of the speakers at Bass's retirement ceremony. It was Delgado who introduced me to the great discoveries made in Japan. He had just returned from Takashima for filming an episode for *The Sea Hunters*.

The divine wind and the lost fleet of Khubilai Khan was not a new story to me. I am a Japanese American, born in Yokohama, Japan, and grew up listening to the story of the *Kamikaze*. I decided to go to the United States to study archaeology and have participated in several excavation projects overseas, including Oman, Yemen, and Turkey, planning to become a specialist in Bronze Age Indian Ocean trade. Through participating in these excavations and conducting my research, I became interested in how people in the past interacted across a long distance using vessels. I had my dream set on becoming a Middle Eastern archaeologist, but when I heard about the discovery that Japanese archaeologists had made at Takashima, my goal was set on deciphering the mystery surrounding the original *Kamikaze*. After a brief meeting with Delgado, and also encouraged by Bass, I immediately sent an e-mail to Hayashida asking if there was any way I could join the team excavating at Takashima. I patiently waited for a reply. Several days later, I received an answer—"Yes, you are more than welcome to join the project next summer; people in Japan are waiting for you and we would like to know more about the program at Texas A&M."

I had about eight months to prepare myself to return to Japan to "dive" into the mystery of the *Genko*. I began studying the history of the *Genko* as well as the archaeology of East Asian shipbuilding and seafaring. The history of the Mongol invasion has been a favorite subject among historians in Japan, and I had no trouble in finding many great works done by them. However, all the books and articles that I found did not answer the questions I was asking: what kind of ships did Khubilai assemble, and how were those vessels constructed? These questions cannot be answered by historical accounts alone. Those documents and iconographies that historians focus on so heavily are often mute when describing the details of ship construction. What I desperately wanted was archaeological data from the shipwrecks from that period. To my amazement, I found no experts in the field. Hayashida, one of the only few who had the knowledge and expertise enough to conduct an underwater survey in Japan, was not an expert in the medieval shipbuilding technology of East Asia. Despite being great scholars in their own field, none of the faculty at Texas A&M possessed knowledge on East Asian seafaring. I had to start learning everything about East Asian shipbuilding on my own, without a template to follow. Although it was difficult at first, I began to gather more and more information regarding the status of research in the region. The majority of the published reports were in Chinese or Korean; while I studied these sources and learned more about shipbuilding in East Asia, I realized how little anyone knew about this subject.

Eight months passed before I had fully synthesized the available data. This was the first time in six years that I would be returning to Japan. Strangely enough, I was more excited to join the excavation than to see my old friends and to visit the town where I grew up. I was in Yokohama for only three days before heading to Takashima. The island is in Nagasaki prefecture of the Kyūshū region, 1,000 km west of Tokyo. The airplane left Tokyo at 6 a.m. and arrived in Fukuoka, and I then had to use a subway and a train, a bus, a taxi, and finally a ferry to reach Takashima. The outline of the island resembles the shape of a bird spreading its wings and is also famous for a large number of hawks that live there; thus it is called "hawk island" or "Taka-shima." Approximately 2,000 inhabitants of the island, most of them senior citizens, grow tobacco leaves and raise blowfish (the famous *fugu*) for a living. It is not the typical Japan that western people usually think of. This is the countryside of Japan, far removed from large cities. The island's treasure is the lush and vivid green forests and the deep blue ocean.

When I arrived at the island of Takashima, Hayashida welcomed me and introduced me to his equally welcoming team. They took me to the local museum where the timbers raised were waiting in large containers to be recorded, analyzed, and conserved. Hayashida showed me many of the precious artifacts from the excavation and explained the significance of each one. He told me the stories of how those artifacts were found, and how excited he was to see them for the first time in the seven hundred years since the legendary storm sank them. I could not wait to begin diving the next day, but I was equally tired from the long trip. Those who work in underwater environments know that what seems to be a simple task on land requires greater physical strength underwater (fig. 8). Divers sometimes have to swim against the current to conduct careful excavation and recording; depending on the condition of the sea, visibility may be limited to one foot or less. The time that a diver can stay underwater is also limited to prevent decompression sickness. Despite these working conditions, I was ready to help reveal the secrets of the *Kamikaze* the next morning.

We worked as a team that usually consisted of two or three persons. The area being excavated this season was not extensive, and

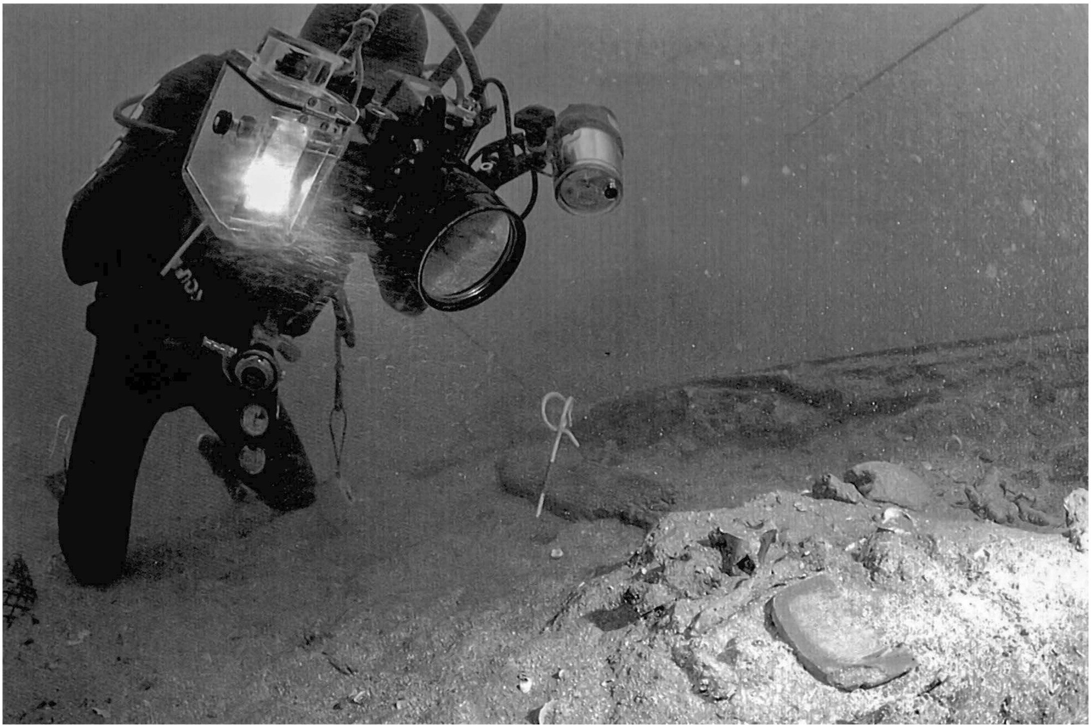

FIGURE 8. Diver at work at Takashima. Courtesy of Matsuura Board of Education.

three divers was the maximum number that could work comfortably in the research area. The site was located near shore at a relatively shallow depth of 9 to 12 m. We did not use our fins but instead "hopped" underwater to get to the site. I was excited and hoped to see the seabed covered with artifacts; however, all I found was murky water and a big hole at the bottom of the ocean floor. The entire site was covered by 2 m of silt, and this all had to be removed. The team used a water dredge, an underwater suction device, to remove the silt. It took about four days before I started seeing some artifacts. We had three, sometimes four teams, working twice a day for about fifty minutes each. They excavated the site efficiently, and soon the seafloor was cleared of its overburden of mud, revealing scattered artifacts related to the invasion.

These artifacts had once been held by the Chinese, Koreans, and Mongols who came to invade Japan before the legendary storm buried them at the bottom of the sea. As I worked, I wondered if the sword that I found had been used in combat. Who had owned it? We also found a bowl, perhaps a rice bowl, among other ceramics. Using it, an individual had eaten meals on board the crowded ship after leaving his homeland. Had he survived the storm, or was he killed before the storm by a samurai? What was the name of this person? I thought of many such questions throughout the day, but there were no answers. This is the site of a disaster where tens of thousands of lives were lost—and when you excavate such a site, you cannot do so without emotion. Seven hundred years separate that past event and today, and yet these artifacts found underwater are timeless objects. The pots, swords, and armor that I uncovered from the ocean floor had been there since the time of the *Kamikaze*.

Once the silt was removed and the artifacts were exposed, the team began to record all of the details for each of the artifacts. Photographs and video recordings were made along with drawings. These drawings are important data, because once the artifacts are removed from their positions, there is no other way to reconstruct the site as it was found. Archaeology is a destructive science, and one must keep a perfect record of what artifacts were found where. Without this level of documentation and record keeping, excavation is nothing more than relic hunting.

One of the most difficult (but interesting) aspects of underwater archaeology is conservation. The underwater environment often alters the chemical and physical properties of artifacts. Every artifact must go through the process of conservation prior to being handled in the open air. Iron artifacts react with dissolved chemicals in seawater and create what is known as a concretion. The actual iron may be completely dissolved, but it leaves the cast of the original artifact behind. Waterlogged wood may appear strong, but is often porous inside and has a consistency just like tofu. Once the wood becomes dry, it will warp, shrink, and often crumble into pieces. Artifacts must therefore be kept wet all of the time, and the process of conservation may take years or often a decade or two depending on the size and con-

FIGURE 9. Timbers awaiting conservation at Takashima Matsuura. Courtesy of Matsuura Board of Education, photo by author.

dition of the artifact. All artifacts discovered at the site were kept at the local conservation center specifically established for the purpose of ensuring that everything recovered from the Takashima underwater site will be preserved for further analysis and research. Unfortunately, the conservation center does not possess either the capacity or the funding to conserve all artifacts at this time because an unexpectedly larger number of artifacts was found at the site. These artifacts are placed in water tanks awaiting treatment (fig. 9). We have to patiently wait for all conservation to be completed before we can realize the full potential of these discoveries, and this may take more than twenty years.

Research at Takashima

"Do you want to stay on the island and record the hull timbers from the wrecks?" Hayashida asked me after a few days of diving at the site. He continued, "This is the first time that such a large amount of hull fragments have been discovered in the country, and there is no archaeologist in Japan who can study these hull fragments." After Hayashida asked me, I glanced at the timbers in the water tanks. Indeed they came from the ships that the Mongols brought to invade Japan; I was at the right place at the right time. The answer was simple: "Yes, I'll do it." The team, especially Hayashida, not only believed in my potential but they also wanted to see the timbers properly analyzed and results published. They wanted many people to know the history and archaeology of the Takashima underwater site and the real story behind the legend of the *Kamikaze*.

Although my visit to Takashima was brief and I was always tired from the hard work underwater, I knew what needed to be done. After I returned to Texas, I quickly drafted a project proposal and sent it to the Takashima Board of Education, which managed all archaeological activities conducted on the island. The focus of my proposed research was analyzing the details of the ship timbers recovered from the site. While excavation is the process by which one finds artifacts, it is during analysis and recording that those great discoveries are often made. It was a privilege to work at such an important site. The timber recording was to be conducted in the summer and fall of 2004, and again during the summer of 2005, when I would complete the final analysis. The aim of the project was to investigate, identify, and understand the hull fragments raised during the 2000–2004 seasons. I submitted the proposal to the Institute of Nautical Archaeology (INA) at Texas A&M University, which supports student projects. I was not certain if the project would be approved because the study of East Asian seafaring has not been a focus of the institute. To my surprise, INA announced its support of my project, along with the RPM Nautical Foundation, a funding organization for nautical archaeological research. I was ready to return to Japan to analyze the wooden pieces that might reveal more of the secrets of the *Kamikaze*.

I returned to Takashima in early summer of 2004 and spent the first several days determining how best to record the fragile and fragmented wood. The plan was to stay until late November and record as many timbers as I could. However, the site had yielded more than five hundred pieces of hull timbers, and I did not have enough time to record everything in detail. These timbers, after seven hundred years in the sea, had degraded to where the wood would crumble just by touching them. My main concern was to understand the nature of the site and what types of ships were brought to Japan. At the same time, it was necessary to comprehend the overall nature of all findings. The first phase was to make a quick sketch of all timbers with maximum dimensions, note any anomalies and features, and create a photo database.

I ultimately recorded a total of 502 timbers. This represents the majority of the excavated timber remains from Kōzaki Harbor between 2000 and 2004; conservation processes meant that some timbers were not accessible for detailed study at the time. Because of this, some large timbers such as the anchors were not recorded. However, some of these artifacts had been previously recorded, and I will discuss them separately from the timbers I recorded. Because the excavations conducted at Takashima were mostly related to the rescue excavation that resulted from harbor construction, the timbers came from relatively shallow areas that were close to the present shoreline. Most of the excavations took place at locations shallower than 20 m in depth. At this depth, the seafloor is directly affected by the current, and the site is therefore likely to have been heavily disturbed. This is evident by finds of modern trash often mixed in with the artifacts from the invasion and yet covered by 1 to 1.5 m of heavy silt deposit. A 10 m by 10 m grid was established during the excavation, with letters assigned to the east-west line and numbers assigned to north-south lines (fig. 10). Artifacts were found distributed throughout the grid. Almost all of the artifacts were isolated finds. Ceramics, arrows, timbers, and various other finds were spread over the excavated area. As for the hull remains, only five timbers were still joined together. Also, two fragments found 20 m apart at the site were later determined to be from a single item. At such a site, a clear research plan had to be proposed to fully realize the potential of the finds.

After recording the maximum surviving lengths of the timbers, I realized that 230 of them were less than 25 cm in length, and 110 timbers were between 25 and 50 cm. Only 9 timbers were 200 cm or longer. In other words, more than 90 percent of the timbers were 100

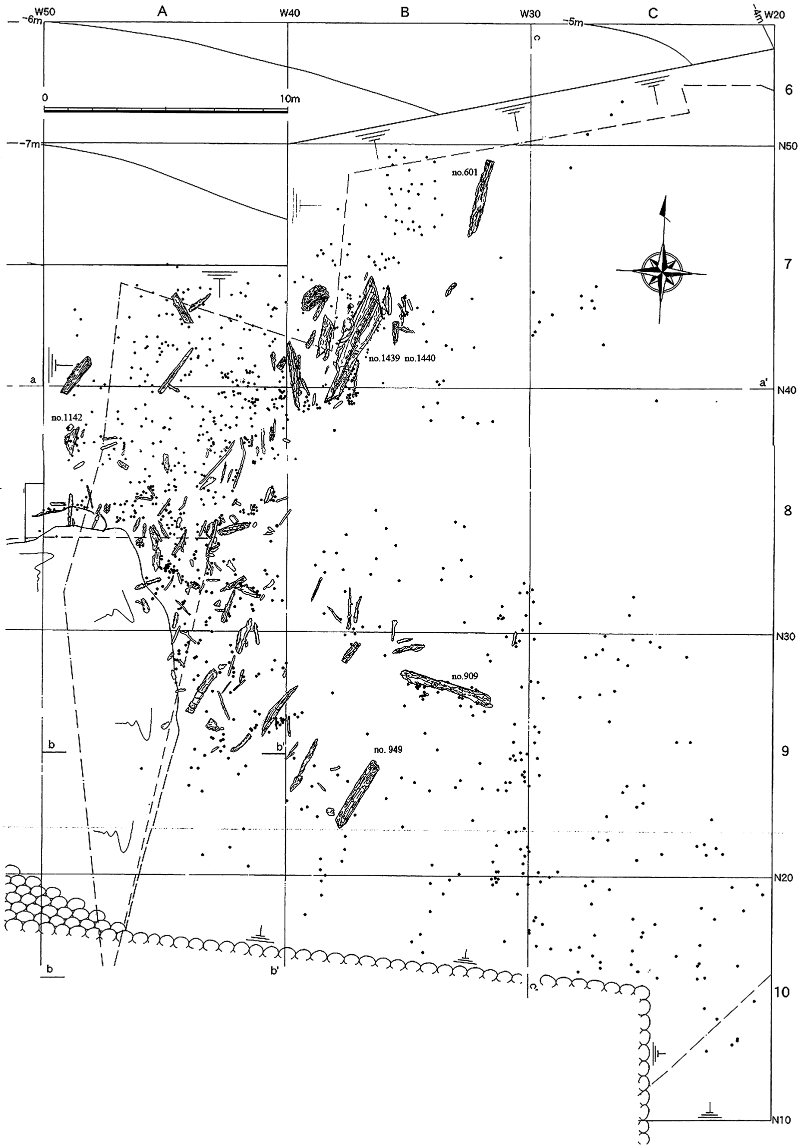

FIGURE 10. Site plan of the Kōzaki Harbor excavation, 2000–2004 (from Takashima Board of Education 2003, plate 9–10). Reprinted with permission.

cm or smaller, while less than 2 percent of the items were larger than 200 cm.[15] The dimensions of the surviving wood are therefore good indications of the turbulent conditions that have affected the site. Instead of a vessel, all I had to work with were small pieces of wood. While recording the dimensions of the timbers, I decided to assess the degradation of each timber; all timbers were classified according to a system of five ranks that reflected the preservation of original shape. Rank 1 was assigned to the timbers whose original length, width, and thickness were complete. Rank 2 was assigned when the hull element was broken in one plane, usually in half. The original length may be lost, but the original width and thickness could be recorded, and thus the timbers from rank 2 still hold valuable information. Rank 3 was attributed to timbers that were broken in two planes or directions, but the original length and width were lost in this case. Rank 4 was the designation for unidentified timbers, preserving at least a nail or a modified surface. Rank 5 comprised all unidentified fragments with no trace of human use and modification. These could include driftwood or a small fragment of a larger component. Only 32 timbers were assigned to rank 1, and 162 timbers to rank 5. Nearly 60 percent of the timbers were included in ranks 4 and 5.[16] These statistics show how almost all of the timbers were broken and degraded when they were found.

Because the context of the finds at the site provided no clear answer regarding which timber belonged to which vessel, each timber had to be examined and organized by a simple architectural method. This was not easy; it often seemed as though the 4,000 ships were smashed into small pieces and tossed into the sea. Because my focus was identifying how each piece once fit and functioned within a hull, I separated all timbers into categories based on hull construction components. By separating the timbers into certain "best guess" categories, it was easy to compare them within each category as well as compare them with archaeological evidence from other sites. Results of the category analysis of timbers are found in chapter 5.

A simple photograph and sketch of the timbers are good tools in recognizing the overall nature of the site, but this method does not provide detailed knowledge of individual timbers. Thus, I have selected 100 timbers for detailed recording. The choice was based on the rarity of finds and also recorded typical timbers from each category. For the recording process, it was necessary to record all sides of the wood, including one nearly 6 m long bulkhead plank, while making sure it did not get dry. Everything had to be handled with extreme care. Because the work had to be conducted around standing water, ordinary papers would not have worked. I used Mylar or other plasticized paper to record the timbers. I wore either a wet suit or a swimsuit while working, which was not particularly comfortable during cold months. Most of the recordings were done to a 1:1 scale—or 1:5 or 1:10 for larger hull timbers. While I was in Takashima, KOSUWA conducted another season of excavation. I joined the excavation team during the day and returned in the evenings to my own work on recording the timbers. Having the excavation team there was a great help because they assisted me in rearranging the timbers in the water tank to record them more easily, and they helped turn the large timbers sideways and upside down. It is not an easy task to turn a 6 m long spongy piece of tofu, saturated with water, and not damage or break it. Most of the recordings I made are used to illustrate the timber category database just described above. Some of the timbers, however, do not fit into any particular categories and must be analyzed on an individual basis. I have selected several of the timbers recorded to be made public in this book, which are found in chapter 6.

Along with the timber category database, I have used other analytical methods to glean information out of the timbers. One method employed was wood species analysis. Chinese shipwrights' documented preferences of wood and the data from excavated ships were compared with the results from Takashima. This analysis provides distinct evidence for the origin of the wrecked vessels at Takashima. I also focused on the differences in joinery systems. How a timber was joined to another piece of timber, particularly its nailing pattern, was the primary means used to organize the timbers. Due to the destructive nature of the site's environment, the remains of joinery was often one of the only features that could be studied on a timber. The major division I selected was between those using iron nails and those employing a complex wooden joinery system. The data was again compared to archaeological evidence from other excavated East Asian vessels. The result of the species identification and interpretation is discussed in chapter 7 and the study of the joinery in chapter 8.

Once I completed the recording of timbers, there were still many questions to be answered. Still, I had to return to the United States to finish my course work while I analyzed the data and wrote my thesis, which became the basis of this book. The analysis took longer than I expected because new discoveries were always being made. New sites provide new information, and whenever I heard of a new publication, I had to readjust some of my findings. One pitfall that many archaeologists fall into is that they cannot stop adding new and better information; however, this is not ideal because the information that they have will never be known to the wider world. I know that my research is still incomplete, but if I do not publish the results now, the important discoveries will not be seen by the public.

Chapter 2

History

ARCHAEOLOGY AND HISTORY have always had a symbiotic relationship, and it is especially true for nautical archaeology because most of their work focuses on a particular event, usually a shipwreck event. The study presented in this book is no different. A shipwreck is often portrayed as a time capsule, and the evidence gathered from such a site is used to reconstruct a historical event. Archaeology provides detailed accounts of what historical documents cannot tell, and history gives archaeological evidence a meaning. In more specific terms, it is important to know why the Mongols invaded Japan so that we can place the *Kamikaze* in its proper historical context. For this reason, we must understand how the story of these invasions is told in the historical documents. Thus, in this chapter, a historical background of East Asia before the Mongol invasion of Japan and the actual events surrounding the two Mongol invasions will be illustrated briefly. The most important events are shown in a time line in appendix A.

East Asia before the Mongol Invasions

Beginning in the sixth century CE, Arab and Persian merchants began to trade with China, mainly over the existing Silk Road, but others reached southern China by sea.[1] The fame of the Tang dynasty (618–907) stems from the expansion of this extensive trade network. This was the time when the Silk Road flourished both on land and sea. This network brought goods from India and Southeast Asia to China and from China to the rest of the world. Trade was based on a tributary system whereby officials from another country brought goods to the Tang court and the government then sold the items to private hands.[2] In exchange, the country that brought the goods came under the protection of China.[3] Japan also imported numerous goods from China, which began to appear in Japanese documents at this time. These goods are often found in the archaeological record.[4]

The glory of the Tang dynasty did not last forever. The government was weakened by internal struggle, lost effective control of the country by the ninth century, and the dynasty fell. After a period of unrest, a new dynasty, the Northern Song dynasty (960–1127) was established. Initially, the dynasty held the country in unity, but nomadic invaders soon took over the northern half of the country. The Khitan of northern China gradually settled in Chinese cities and created the Liao dynasty (916–1125), and later the Jurchen tribes created the Jin dynasty (1115–1234). In response, the Song court moved its capital to southern China and created what is now known as the Southern Song dynasty (1127–1279).[5] In order to defend and finance the country, the Song court encouraged overseas trade, and thus maritime commerce became a dependable source of income.[6] The traditional trade route for China, the Silk Road, was now blocked by the unfriendly kingdoms, and the Chinese had to seek alternative trade partners. This led to the opening of more seaports and the government's emphasis on maritime trade. A powerful merchant class emerged, and the tributary system was abandoned by the state. In 1132 the Song established a professional navy and offered prizes for new naval inventions. This led to major nautical innovations, including the compass, which Chinese called the "south-pointing needle."[7] International maritime trade flourished, and cities such as Quanzhou in the province of Fujian and Ningbo, located in the Yangtze estuary, became major centers of trade.[8] Despite the fact that China was divided, with the border delineated by the Yangtze River, the Southern Song dynasty was a strong economic superpower.

The Southern Song's status as a maritime empire was, however, gradually destroyed by powerful invaders from the north, the Mongols. When Temujin, better known as Genghis Khan, rose to power in the late twelfth century, the number of his troops grew with successive conquests. His well-trained cavalry units, organized by the decimal system, swept the plains of Asia, eastern Europe, the Middle

East, South Asia, and East Asia to create the largest empire that the world has yet seen.[9] The Mongols gradually spread their control into northern China and Korea. Northern China was administered by Khubilai, a grandson of Genghis.[10] Khubilai became involved with Chinese politics and embraced Chinese culture.[11] His aspiration was to conquer the Southern Song dynasty and become the reigning emperor of the Chinese civilization.[12]

The Southern Song Empire was a strong nation, and conquering it did not take place overnight. Although the power of the empire was waning as a result of protracted warfare, the dynasty retained an extensive naval force that was supported by the revenues from overseas trade.[13] The Mongols, on the other hand, lacked an organized naval force and were thus kept at bay by the Chinese navy along the Yangtze River, the border of the Southern Song. "Without ships, the Mongols could not subjugate Song," says Morris Rossabi, an authority on Mongolian history.[14] The Mongols were quick to learn and adopt new weapons and technologies, however. They realized the importance of the naval forces and created a special unit to organize naval fleets. In addition, the Mongols welcomed Song defectors who had knowledge of shipbuilding. The Mongols also captured the enemy's ships and incorporated them into their military. Despite the effort, it was not easy for the Mongols to defeat the naval empire; it was necessary to weaken the Song's economy from within. Some scholars argue that the strategy that the Mongols used was to curb Song profits from trade.[15] Khubilai decided to weaken and isolate the Southern Song cities; to do so, he initiated a campaign to invade the Song's principal trading partners, Korea, Dali (modern Yunnan), Vietnam, and eventually Japan.

The Invasion of 1274

When the Mongols emerged as a superpower, Japan was ruled by a feudal military government, the Kamakura Bakufu (1192–1333), a loose confederation of many clans that had vowed to obey the shogun, who in turn bestowed rights pertaining to land as a token of mutually beneficial relationship. Although merchants from China frequently visited Japan, the Japanese government prohibited its citizens from traveling to foreign countries except when going as a student or a monk as well as traveling for official state-funded trade.[16] However, private smuggling was known and perhaps more common than available documents may suggest.[17] Hakata on Kyūshū Island became a major international city where merchants from the Southern Song visited frequently.[18] Many Chinese lived in Hakata, creating what might be called a "China Town."[19]

In 1267 the Mongols sent an emissary to Japan. Copies of the letter he carried survive to this day, and according to their contents, the Mongols demanded a trading relationship with Japan. More ominously, the emissary told his Japanese hosts that Japan had to accept the Mongols as a superior power and warned that they would use force if Japan did not comply.[20] The Bakufu sent back the envoy without providing an answer.[21] The Mongols sent similar missions several more times, but Japan showed no change in its policy. Khubilai decided to enforce his will by launching an invasion from the sea from nearby Korea. Korea suffered from a series of Mongol invasions for several decades, and it was Khubilai who finally took firm control of the peninsula. After suppressing the last Korean resistance, known as the revolt of Sambyolcho in 1273, Khubilai gave the people of Korea no time to rest. In January of the next year the Mongols ordered the Koreans to build nine hundred ships; the vessels were to be ready by the beginning of the summer.[22] The main fighting force was to be made up of Mongols and northern Chinese who had already been stationed in Korea for several years. The Mongols and Chinese numbered 20,000 troops, while Korea provided 6,000 men.[23] Somewhere between 6,700 and 15,000 sailors from Korea were also employed in manning the vessels of the invasion fleet.[24] The various estimates can be summarized as follows:

Estimate by Rossabi (1988):
- 300 large vessels; 400–500 small vessels
- 15,000 Mongol/Chinese soldiers; 6,000–8,000 Korean soldiers; 7,000 Korean sailors

Estimate by Ōta (1997):

900 vessels (1,000-*liao, baator* [fighting], and water transport vessels)
26,000 Mongol/Chinese soldiers; 6,700 Korean sailors/soldiers

These combined forces left Korea in the late summer of 1274. They soon took control of Tsushima and Iki Islands and then quickly advanced to Hakata Bay.[25] The Mongols landed, burned the city of Hakata, and proceeded further inland.

The Mongols were equipped with more superior weapons than the Japanese, including incendiary weapons which Japan had never seen before, and Mongol tactics based on fighting as a unit were unfamiliar to the Japanese, whose fighting style emphasized individual valor. The Mongols initially fought well; however, they apparently faltered and retreated back to their ships. The reasons for this retreat are difficult to identify, although some (mainly western) scholars claim that there was a storm.[26] Indeed, there are some conflicting sources of evidence, but it appears that the retreat took place prior to the storm, if there was a storm at all.[27] Furthermore, the decision to return to the ships when a storm is approaching does not make much sense, especially after gaining control over a piece of land. It is assumed that the Mongols returned to their ships not because of the storm but for other reasons. The Japanese contemporary historical document *Hachiman-Gū Dōkun* (八幡宮童訓: The Tales of Hachiman Buddha) mentions that when a certain priest was trying to evacuate an important Buddha statue, he noticed that the rain had started; he looked for a cloth to cover the Buddha to prevent it from becoming wet.[28] Thus, it is certain that the weather was not perfectly calm, but there was no violent storm.

Regarding the reason for the Mongol retreat, Japanese historian Kōki Ōta notes an interesting hypothesis. A record of the Yuan dynasty known as *Yuan Shi* (元史: The Official History of the Yuan Dynasty) describes the retreat, mentioning that “the troop was not organized” and “all the arrows had been used.”[29] Another hypothesis is that the combined forces of Mongols, northern Chinese (Khitans and Jurchens included), Koreans, and possibly other ethnic groups were numerous but were not able to fight well against united Japanese forces.

Another possibility for the quick retreat is that the main reason for the first landing was more in the nature of a raid than a full-scale invasion; perhaps its main goal was to attack and burn the town of Hakata and to weaken an important source of income for the Southern Song cities. In this respect, the first invasion was not a defeat for the Mongols; the first invasion may have been a tactical success and evidence of a greater genius. The Hakata-centered trade was profitable for the Chinese mainly because Japan based the value of the coin on the value of its metal, while China minted coins to collect taxes, and its value was artificially fixed by the government.[30] Even coinage that stopped circulating in China centuries before was still valuable in Japan but had no value in China as a currency. This is demonstrated through one nautical archaeological site, the Shinan shipwreck, which originated in China and was shipwrecked during the Yuan dynasty with seven million brass and copper coins on board that included, as its earliest coin, one dating from 14 CE.[31] When the trade was cut off, Chinese cities lost their source of wealth and finance, thus weakening the empire. If this hypothesis is true, it demonstrates that Khubilai was not distracted from his ultimate objective, conquering the Southern Song Empire, and may have attacked Japan in part to aid that goal. The loss of the Southern Song dynasty's trading partners and the subsequent stagnated economy as well as the long wars with the Mongols led to a decline in the Chinese people's will to fight. The Mongols had already taken control of the countries surrounding the Southern Song, and with resistance collapsing, the march toward the capital and the defeat of the empire was a relatively easy game for the Mongols. Khubilai's success in China can also be attributed to convincing his opponent's naval officers to join forces with the Mongols, which eventually led to the fall of the Southern Song dynasty in 1279.[32] Here Khubilai Khan became the sole ruler of all of China, the emperor of the Chinese Yuan dynasty.

The Invasion of 1281

Khubilai's legitimacy as a ruler was always contested.[33] He was chosen as the Mongol emperor, not in his homeland but in China;

and he was an emperor of China, but he was not Chinese. To prove his authority and to gain strong support, it was necessary for him to conquer foreign lands. In the manner of authoritarian rulers throughout history, Khubilai saw a major military effort against an outside foe as a way to unify his subjects and maintain his position as an emperor.[34] Soon after conquering the Southern Song, Khubilai decided to invade Japan yet again; the Mongol retreat after the first invasion might have given Khubilai a feeling that this was an "unfinished" job. After the first invasion, the Japanese feared that the Mongols might soon return with a greater force and even considered mounting a counterattack on Korea to disrupt any preparations that might be taking place; however, this plan never materialized. Instead, the Bakufu ordered the construction of stone walls along the coast where the Mongols might land.[35] The Mongols again sent emissaries demanding submission, but this time the Bakufu beheaded them.[36] This act of rudeness and cruelty (seen from the Mongols' perspective) was considered a declaration of war against the Mongols.

Several historical documents, including *Yuan Shi*, already mentioned above, can be used to reconstruct the invasion of 1281. Written sources mention that two separate armies were organized for the second invasion; the Eastern Army set out from Korea and the Southern Army sailed from the mouth of the Yangtze River. A Japanese historian who specializes in the Mongol invasion of Japan notes that the Eastern Army was the principal fighting force, while the main purpose of the Southern Army was to support the operation, to carry the grain and other supplies to the front.[37] A detailed discussion of the naval organization is discussed in the next chapter.

In the original plan of the 1281 invasion, the two armies, the Eastern Army from Korea and the Southern Army from South China, were to meet at Iki Island off Kyūshū around mid-June.[38] Following their orders, nine hundred ships from Korea crossed to Tsushima and Iki Islands, taking control of the Tsushima Strait. The Eastern Army waited for the arrival of the Southern Army; however, the commander of the Southern Army, Arahan, was struck ill and Atahai took charge in his place.[39] The Southern Army, consisting of between 3,000 and 4,000 ships, left the mouth of Yangtze River in late

June, the date originally designated to rendezvous with the Eastern Army.[40] While waiting, the Eastern Army's commanders complained that their ships were rotting and the troops had no food to eat.[41] They had engaged in some skirmishes but did not take control of the mainland. Perhaps the walls that the Japanese had constructed prevented the invading troops from landing.

In late July the two armies finally met near Hirado Island, far southwest from the original location where they had decided to meet. The two fleets remained there for several days and advanced to Takashima Island in Imari Bay.[42] The Mongolian Army took control of the island, wiping out its inhabitants. Only a handful of people survived the massacre, according to legends of the event told on the island to this day.[43] After a few days of fighting at Imari Bay, a typhoon struck the area, crushing the invading fleet. *Goryeo-sa* (高麗史: The Chronicle of the Kingdom of Goryeo) mentions that "about 100,000 troops of the Southern Army came, met with large wind, and all the Southern Army died."[44] Many who survived the typhoon fought against each other to get on board the vessels that were unharmed by the storm.[45] Most historical sources agree that the majority of the damage was inflicted upon the Southern Army; one source estimates that 70,000 of 100,000 troops died.[46] Most of the Eastern Army, on the other hand, returned safely to Korea.[47] The Eastern Army used smaller vessels that could have been beached during the storm, or the Korean sailors may have anticipated the coming of the storm and returned to Korea before it struck. The Japanese took the great wind as an opportunity to hunt down enemies who had survived the storm, and the battle ended in a total Japanese victory. The people of Japan believed the wind was brought by the gods to protect the nation from foreign invaders and thus affirmed that the Japanese were the chosen people of the gods. Temples and shrines demanded that the Bakufu pay rewards for continuous prayers that brought divine intervention.[48] Despite their victory, the Japanese continued to believe that the Mongols would attack again, and so the Bakufu ordered a continuous patrol of the waters of Japan.[49] This threat was real, as Khubilai had made plans for a third invasion. But southern China did not have enough resources to prepare for the next invasion, nor was it the will of the people. Some showed their disapproval of the new Mongol rule by a revolt.[50] Khubilai, therefore, ordered the areas unaffected by the two previous attempts, northern China and Manchuria, to prepare ships for the invasion.[51] Many of the Mongol Empire's high-ranking officials advised against Khubilai's plan and finally persuaded him to abandon the next planned attack on Japan. When the third invasion was officially canceled, it is said that the sound of celebration was like the sound of thunder.[52] Vessels already being built for the third invasion were sent to invade Sakhalin, Vietnam, and Southeast Asia instead, but all of these campaigns failed.[53] Perhaps this is another important story that needs to be told elsewhere.

The maritime legacy of the Mongol Yuan dynasty is one of continuous invasions, but all of Khubilai's attempts to subjugate his foes with seaborne armies had failed. Khubilai died soon after hearing of the failure of his overseas expeditions in Southeast Asia, and weak rulers succeeded him. The power of the Mongols in China began to wane, and the new empire of Ming was established in 1368. The maritime power that China had once possessed gradually declined.

The China Town in Hakata declined after the invasions, but the Japanese merchants were able to move more freely around the sea because Korean merchant activities had also declined.[54] One result of this new trading pattern was that elements of Chinese culture, such as tea and ceramics, became increasingly popular in Japan.[55] The lasting impact of the invasion in Japan was the financial collapse of the Bakufu and the loss of leadership. The invasion also took a toll on the samurai's livelihood. Japan mobilized a large number of fighting men, and this was not an easy task in the thirteenth century. Constructing the stone walls as well as maintaining provisions and patrol exhausted resources and manpower. Many samurai fought the battle in hopes of gaining land in return for their service, for this was the basis for the feudal authority. However, the Bakufu did not gain any new land and was not able to honor the services that his vassals performed.[56] The result was the emergence of new powerful clans that hoped to topple the rule of the established authority. In 1333 the Kamakura Bakufu was overthrown and the Ashikaga family established a new ruling dynasty, the Muromachi Bakufu (1333–1573).[57]

Chapter 3 Naval Organization

IN CHAPTER 2 THE historical background of Asia provided the meaning to the findings at Takashima. Before moving on to the story of discoveries made at the site, this is a ripe time to discuss the details of the naval organization of Khubilai's era. In other words, a discussion of what we already know about the ships and naval organization is needed in order to gain an insight from the remains. In this chapter, therefore, I will first describe the Chinese naval organization of the Song and Yuan periods based on historical and iconographic evidence. The number and types of ships are the main topics to be discussed. Following this, descriptions of the East Asian ships, namely the vessels built in Korea, along the Yangtze River, and in the province of Fujian, will be provided. A number of historical, iconographic, and archaeological data exist for revealing the types and features of the watercraft. The chapter will close with a discussion of the most likely organization of the fleet, specifically for the second invasion of Japan. This "likely" organization is a working hypothesis but appears to correspond well with the archaeological evidence gleaned from timber remains at Takashima, as we will see later.

Naval Organization Based on Historical and Iconographic Evidence

G. R. G. Worcester, an expert on traditional Chinese rivercraft of the Yangtze River, once wrote: "China holds scholarship in high honor, but apparently they did not concern themselves with naval history or nautical lore."[1] Other scholars, including Joseph Needham, were also aware of the apparent lack of historical documents regarding the ships of China; Needham noted that comprehensive nautical treatises were rarely written in China.[2] Nonetheless, numerous naval battles took place throughout the history of East Asia on rivers, lakes, and open seas. Both inland and ocean maritime trade had also played a vital role in Asian economies. Although historical accounts do not contain detailed information regarding construction techniques, some useful information regarding shipbuilding, outfitting, and handling practices can be ascertained.

Despite the lack of documents regarding nautical tradition, the Chinese wrote extensively on warfare with a particular emphasis on who was involved, how many soldiers were in a battle, and the course of the event. Historical documents generally record the number of ships present in naval engagements; however, it is difficult to interpret this number because there are no means to verify the exact count and the figures appears to be exaggerated in many instances. The types of ships are rarely mentioned, and thus the modern-day scholar cannot tell if the number refers to all the vessels, including ship's boats, or only to the large vessels. Historical documents note the number of ships involved and the number of ships captured during a battle. According to these accounts the Mongols usually captured or confiscated from 100 to 2,000 ships per engagement, but one recorded instance mentions 50,000 vessels taken by them.[3] Documents that mention the number of ships produced in a specific shipyard also exist; for instance, at the cities of Mingzhou, Wenzhou, and Taizhou; each city had close to 20,000 vessels registered in 1257.[4] These accounts give an idea of the size of the naval forces usually involved in Mongol campaigns. During the Song, Yuan, and Ming dynasties, some naval vessels in service were made at government shipyards, and some were former pirate vessels, but most were converted from merchant vessels. The employment of merchant craft for naval purposes was a common practice of the time.[5] Thus, it is certain that captured vessels as well as pirate and merchant vessels needed repairing or refitting to be used for naval services. The discussion of repairing and refitting of ships brought to Japan is discussed in detail in chapter 9. Considering the evidence, the size of the fleet assembled to invade Japan, about 4,000 ships, is not that much different in scale from other Mongol campaigns; however, this is not to say that the account of the invasion of Japan is true because it is possible that the number may be inflated.

The number of ships involved for the invasion is only one side of the story. Historians and archaeologists must reconstruct what types of vessels were necessary for attacking Japan. The accounts of foreign travelers to China are worth mentioning here. The Italian merchant Marco Polo is said to have visited China during Khubilai's reign. He described Chinese vessels, shipbuilding practices, and naval organization in remarkable detail. According to Polo's descriptions, the large vessels could carry 300 men and up to 360 tons of cargo. A large vessel carried two or three large tenders and was also able to take up to ten small boats. Most of these boats were lashed to its sides and two or three were towed astern. Some of the larger ships towed a full-sized vessel that had its own sailors.[6] Ibn Battuta, an Arab traveler who visited China around 1347, described naval practices at the time. According to Battuta, large ships carried 1,000 men, 600 sailors and 400 marines, had four decks and twelve sails, and were followed by three small vessels.[7] Polo's and Battuta's accounts illustrate how naval units were organized with one large vessel followed by many smaller vessels to create a complete unit. These accounts suggest that a unit comprised several ships and one large vessel carried several smaller boats together. Perhaps fifteen or twenty vessels may have functioned as one unit, and thus, 4,000 ships and boats is a feasible number for the invasion force sent to Japan. Not all ships were large, but the fleet was composed of various types of vessels.

Different ships had different functions, and this statement must be examined more carefully. In general, seagoing ships were made with deep hulls so that they could stay on course on open waters, but they had to stay off shallow waters to avoid hitting the bottom. This is why large merchant ships had to travel with many smaller vessels. A large vessel had to wait offshore and let the smaller ships and boats go between the ships and shores to carry the goods and people to and from. The classification of ships is not only between small and large, but the Chinese seems to have had a system in organizing the vessels. Navy ships were generally organized by size, but more likely they were organized by a function. A document from the eleventh century notes that the vessels were divided into three size classifications according to transverse dimension or their beam. The first class consisted of ships with beams greater than approximately 7.3 m and required crews of more than forty sailors. The second class encompassed ships with beams of approximately 6 m, and the third class approximately 5.5 m or less.[8]

Perhaps the most detailed account of the naval vessels is in *Tai Bai Yin Jie* (太白陰經: Manual of the White Planet), originally written in the eighth century and reprinted in later centuries.[9] This document does not provide information comparable to archaeological evidence, but the description clearly suggests that fleets were organized with several types of special-purpose vessels. It illustrates six types of vessels: tower ships, combat junks, sea-hawk ships, covered swoopers, flying barques, and patrol boats.[10] The tower ship had three levels of decks and superstructures with a fighting platform; the vessel was large and perhaps acted as a flagship to coordinate the fleet. The combat junk was a smaller vessel with ramparts or bulwarks built on deck to provide a protected fighting space. Another interesting vessel was the sea-hawk ship, which was equipped with floating boards (leeboards). Both the covered swooper and the flying barque were fast ships that carried troops; a covered swooper was much larger and longer than a flying barque. A patrol boat was, as the name suggests, a small boat that was used for reconnaissance.[11] These were not standardized vessels in construction features, but were a collection of ships organized by function. These vessels were most likely built at different shipyards and thus even when called by a similar name, each vessel was slightly different from the others.

From this brief survey in Chinese naval organization, preliminary organization of the Mongol fleet can be suggested. First, the number of ships, 4,000 or more, may not have been a hyperbole. Some of the vessels were newly built, and some were gathered, repaired, and refitted from the old Song navy and from merchant and pirate ships. The fleet was organized into a group, probably by size and by function. The largest vessels were about 7 m in beam; smaller vessels were of various sizes. One must note that not all ships were large fighting ships. In addition, not all vessels had to sail to reach Japan, and this fact seems to be overlooked by many casual readers of history. The larger vessels were accompanied by several small boats that were either towed or carried on board, as suggested by Marco Polo. This practice allowed the invasion force to safely bring vessels not suited for open sea to Japan. Large vessels were not suited for battle once they reached the enemy's shore, and so the small and swift vessels were used more extensively on shallow waters.

Perhaps one of the most direct forms of evidence of ships brought to Takashima is the actual illustrations of the ships themselves. The *Mōko Shūrai Ekotoba* scroll depicts at least ten enemy ships, and each vessel appears slightly different from one another; some ships are clearly depicted as landing craft (fig. 11). The structure below the waterline cannot be known, and the size, dimensions, and perspectives are off balance. However, some details that the artist illustrated in the scroll are superb. Some ships are clearly landing craft carrying a large number of troops, each equipped with a shield. These vessels may have been a log-boat type of vessel that had longer overall length compared with the beam. Some large vessels were depicted with oars protruding from the side of the vessel. Some are decked, and one large vessel appears to have a multilevel deck. Deck planking can be seen, and the hold is clearly seen through a possible hatch. Generally, from brief observation of the scroll, one can tell that various types of vessels, including small landing craft, a medium-size vessel, and large cargo ships, were brought to invade Japan. This composition corresponds well with the evidence presented above. Despite the detailed illustrations, this painting alone cannot be used to determine where the ships were made. To answer this question, archaeological evidence must be consulted.

Description of East Asian Ships

For the second invasion of Japan, historical documents state that nine hundred ships were built in Korea, while from China the *Yuan Shi* records that the provinces and towns of Yangzhou, Hunan, Kan-

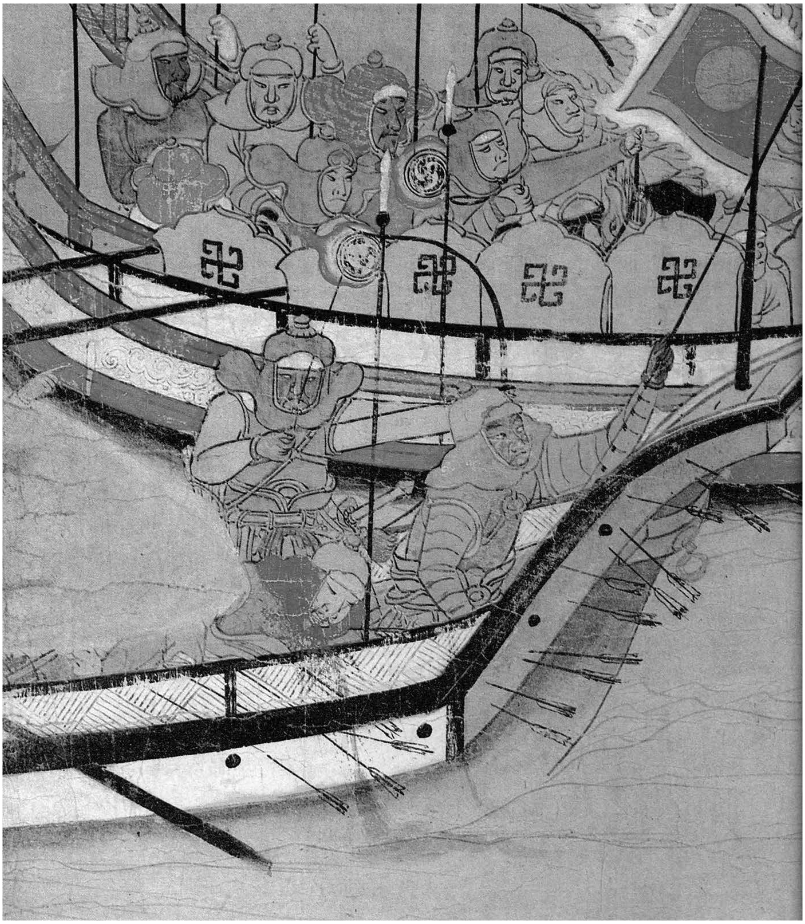

FIGURE 11. Landing craft depicted on the *Mōko Shūrai Ekotoba* scroll. Courtesy of the Japanese Imperial House Museum.

zhou, and Quanzhou were ordered to build six hundred vessels.[12] It is not known if other areas also received similar orders, but it is certain that ships built in other regions were incorporated into the invading fleet. The description of archaeologically excavated ships from Korea, Chinese ships built along the Yangtze River (Yangzhou, Hunan, and Kanzhou), and the ships of Fujian Province (Quanzhou) will be discussed below. Evidence from historical documents and ethnographic records are also used to illustrate the characteristics of these vessels. The descriptions given below are not a complete list of shipwrecks, and many vessels that have been excavated in East Asia are not discussed. The purpose here is to give the reader some familiarity with the materials that will be discussed in the following chapters. Technical terms will be explained for those who are not familiar with shipbuilding terminology.

KOREAN SHIPS

It is natural to assume that a peninsula like Korea would have a strong seafaring tradition. The Goryeo dynasty in particular is considered the golden age of Korean nautical achievement. A unique shipbuilding tradition developed in Korea because of its natural environment. The coastline of Korea is complex; it is dotted with small islands surrounded with mudflats, and it has one of the world's greatest ranges of tidal rise and fall, but once out in the open sea, strong currents sweep vessels away from the land. Korean trading cargo vessels had to withstand the harsh conditions that required a strong flat-bottomed hull, and yet had to sail in an open sea. The answer was a rudder that could be raised or lowered. This is evidenced in traditional documents and is a common feature also found on Chinese vessels, but it was probably more prominently employed in Korean shipbuilding. The shape of the hull was unique to Korean vessels, as were construction features. Unfortunately, the Koreans themselves did not write much about their own shipbuilding traditions until much later.[13] Thus, archaeological discoveries provide much of the evidence needed to reconstruct Korean traditional shipbuilding.

More than a dozen shipwrecked vessels excavated with substantial hull remains provide insight into Korean shipbuilding techniques during the Goryeo dynasty. Some of the famous vessels (starting from the oldest) are the Sibidongpado, Wando, Daebudo, Taean, Talido, and Anjwa ships (fig. 12). The earliest vessel, the Sibidongpado ship, dates to the eleventh or twelfth century, and the latest Anjwa ship

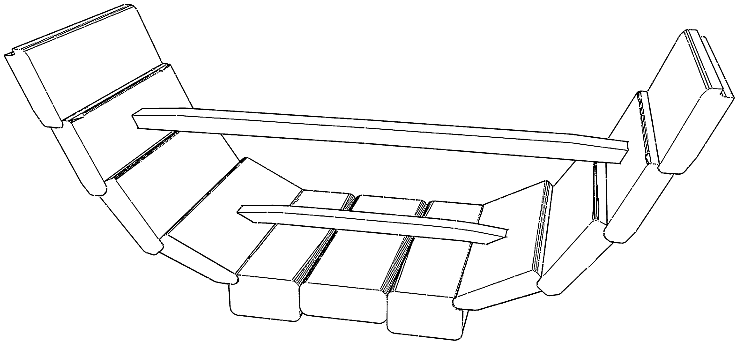

FIGURE 12. Reconstructed model of a cross-section view of a typical traditional Korean vessel. Drawing by author.

dates to the fourteenth century. Despite some differences, these archaeologically excavated vessels all share similar features that attest to the continuous and well-established shipbuilding tradition of the peninsula. Descriptions from later historical documents and iconographies prove the continuation of this tradition.[14] The most characteristic feature of these vessels is the use of heavy timbers, both on bottom and side planks, to construct a hull, as well as joining the timbers without the use of iron nails. These vessels were not large, perhaps no more than 20 m in length and 7 m in beam, with most in the range of 10 to 15 m in overall length and a 3 to 4 m beam. A flat bottom and sharp chine gave these ships a boxlike shape. This shape provided more room for cargo and crew on board these vessels, which had more cargo-carrying capacity than western ships of comparable length and beam. Curved framing as well as bulkheads were not used in Korean shipbuilding. The hull derived most of its strength from heavy timbers that penetrated the hull. These throughbeams were usually around 12 by 4 to 8 cm, but some beams were as large as 30 by 30 cm, such as those on the Anjwa ship. The hulls of Korean ships did not require much internal strengthening because of the heavy bottom planking, which was often more than 50 cm wide and 30 cm thick. The side planking was as thick as the bottom planks, or in some cases was slightly thinner but wider. It is known from iconography and historical documents that Korean vessels had transoms on both the bow and stern. Very few bow or stern sections have survived with the archaeologically excavated Korean shipwrecks, and all were heavily damaged. More research and new archaeological discoveries are required before a more conclusive statement can be made regarding the structure at the extremities of the hull.

As mentioned above, the joinery of Korean vessels is the most important aspect of this shipbuilding tradition. Archaeological evidence suggests that Korean shipwrights followed similar methods in joining planks and this technique changed little over the centuries. To connect the bottom planks, a *jangsak*, or a large and long tenon fitted to mortises cut through the width of the bottom planks, was used. Most often three central bottom planks were connected together with piercing *jangsaks* placed about 1 m apart fore and aft of a scarph. *Jangsaks* were about 8 by 12 cm, with slight variations. The mortise was cut through three planks together, and wedges were placed after the *jangsak* was inserted to hold the planks in place. On earlier vessels, L-shaped chine strakes, carved out from a log, were used to connect bottom strakes and the side strakes. However, this method was no longer in use by the time of the thirteenth century; only the vessels built prior to the twelfth century have these characteristic chines.[15] For later vessels, including the Talido and Anjwa ships, side planks were directly attached to the bottom planks. This gives a more graceful curve to the hull. Side planks of these early Korean vessels had a rabbet cut at the upper outer edge where the next plank was overlapped and connected. The planks were joined with a type of mortise and tenon joinery known as *pisaks*. This type of tenon is unique to Korean shipwrights; a mortise was cut completely through the width of a plank above and to the middle of the plank below (fig. 13). The *pisaks* varied in length, depending on the width of the planks, but typical *pisaks* were 6 to 8 cm in width and 2 to 3 cm in thickness. To hold two planks together, a *pisak* was secured with a peg placed along the lower plank. The *pisaks* were placed directly from the plank above, but it appears that beginning in the thirteenth century, some *pisaks* were placed diagonally. Joinery, such as these just described,

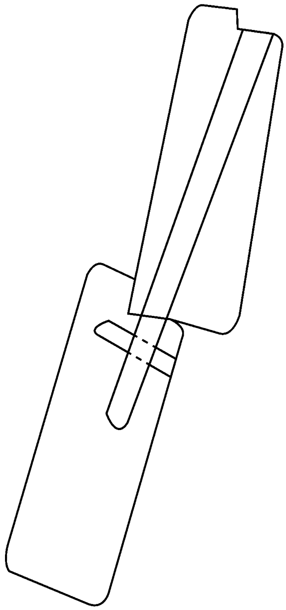

FIGURE 13. Typical configuration of side plank joinery for the hull of a traditional Korean vessel. Drawing by author.

are unique to Korean shipbuilding tradition and are thus considered a diagnostic feature in archaeological records.

CHINESE SHIPS BUILT ALONG THE YANGTZE RIVER BASED ON HISTORICAL AND ICONOGRAPHIC EVIDENCE

The Yangtze River was, and still is, the most important highway in China. The steady flow of water and the long distance it travels sustains Chinese economy. Many towns developed along this river; it is no surprise that numerous towns with a rich history of shipbuilding emerged.

Yangzhou is the city with a great shipbuilding tradition where the Grand Canal and the Yangtze River meet.[16] Many types of vessels were built there, and some of them may have been large ships. It is known that large seagoing junks sailed upstream as far as Nanking.[17] Due to the city's proximity to the ocean and its role as a major center of trade by way of canals, ships of many types and sizes must have traveled through Yangzhou, influencing the shipbuilding tradition of the region. Many seagoing cargo ships came to Yangzhou, and their goods were transferred to smaller inland craft. Yangzhou had a strong maritime connection with Japan. Foreigners engaged in trade with China were required to register at the office of maritime affairs, and many Japanese visitors registered at Yangzhou.[18] For this reason, it is reasonable to assume that ships built at Yangzhou used to travel to Japan. Despite the strong maritime tradition and possible presence of various ship types found in the town, some variety of ships may have been lost in the past seven hundred years. Worcester illustrated various types of vessels built in the area in the early twentieth century; however, almost all were flat-bottom or gently curved-bottom vessels.[19]

The town of Kanzhou, located near Poyang Lake, and the province of Hunan are located inland far from the ocean. At first glance, Hunan Province does not seem likely to possess a great shipbuilding tradition because of its inland location. Poyang "Lake" is actually a series of channels and lakes extending 145 km with a maximum breadth of about 32 km.[20] This area saw the development of shipping because it was a major porcelain production center. Ships requiring a cargo capacity of 100 to 200 tons were developed, and ethnographic studies suggest that they were flat-bottom vessels suited for inland waters.[21] No archaeological evidence of shipbuilding has been reported in this area, but the word Hunan means "south of the lakes," and the area has several major lakes navigable by large vessels. Watercraft surely played a major role in transporting goods and people in this area; in fact, later ethnographic studies do show a thriving shipping industry, usually associated with the timber trade, as well as the manufacture of bamboo cables that were used on board vessels.[22] An ample supply of wood made it easy to construct large numbers of vessels.

One of the most prominent features of Chinese ships was that their ships were built using iron nails mainly driven diagonally from the strake above. The use of bulkheads can also be found in numerous documents as well as archaeological records. Ibn Battuta, the Arab traveler mentioned earlier, described Chinese shipbuilding practices. Besides the large cargo ships that he observed, he described a scene from a shipyard; the bottom was laid down first, and the two "walls" (side planking) were installed next. After this, another series of "walls" (probably bulkheads) were put across the hull.[23] An encyclopedia of medieval China, *Tian Gong Kai Wu* (天工開物: The Exploitation of the Works of Nature), has a section on shipbuilding that notes the bottom of a ship serves as a foundation and is laid down first.[24] Small flat-bottom ships along the Yangtze River were probably built in this style.

Iconographic analysis is another important aspect in the study of Asian shipbuilding. Needham's work is an excellent reference (although many of his interpretations are obsolete), and Wang has compiled a large Chinese iconography of ships.[25] Iconographic analysis entails a thorough investigation of the source; drawings were recopied over the centuries and were often not made to impress people with the accuracy of the subject drawn. Therefore, iconographic study of Chinese ships often ends with disappointing results for archaeologists. One exception is the scroll *Qing Ming Shang He Tu* (清明上河圖: The Spring Festival along the River); this particular work represents much-needed accurate illustrations of Chinese ships. This scroll, drawn during the Northern Song period, portrays details of city life and multiple river boats. The illustration is so detailed that the artist included nail patterns on planks, which is important because it shows these vessels were built with an ample supply of iron nails.[26] The scroll illustrates vessels with superstructures and many details of the decks, rudders, windlass, and other shipboard items.

Archaeological Evidence of Ships Built along the Yangtze River

The historical, ethnographic, and iconographic evidence provides information regarding what types of vessel may have been present. The historical and iconographical evidence seems to be of limited use for the direct comparison of timbers found at Takashima. The archaeological evidence from other shipwreck sites is of primary interest for revealing the secret of timbers from Takashima and thus it must be

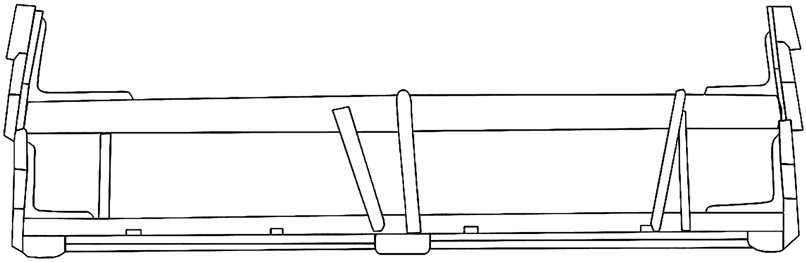

FIGURE 14. Section plan of the Jinghai boat. Redrawn by author, with modification, after Tianjin City Cultural Relics Administration 1983, fig. 5.

discussed in detail. Among many vessels excavated in China, only a few well-known examples will be provided in this book to illustrate some of the key features in Chinese shipbuilding tradition. These descriptions are ordered according to where the vessel was found, from north to south.

An excellent example of a local traditional watercraft commonly known as the Yuanmengkou boat was discovered near Jinghai, Tianjin. It is a flat-bottom boat without bulkheads—which is a somewhat peculiar type of boat in the Chinese shipbuilding tradition. The hull is supported by a series of crossbeams of natural/unfashioned wood.[27] Small frames and stanchions were also present. A thick and slightly rounded timber was used as a chine strake (fig. 14). This watercraft was likely used as a barge that transported local cargoes. This is the only example of such a vessel yet found, and this unique craft suggests that there was no uniform "Chinese" vessel but rather regional variation in ship design and construction.[28]

The Jiaodong Peninsula of Shandong Province is strategically located, extending out into the Yellow Sea and making it a suitable stop for seafarers to replenish their supplies or wait for the wind to change. A system of water and land fortifications developed during the Song dynasty, and the city had become a well-fortified port by the Ming dynasty.[29] A series of excavations spreading over the last few decades have yielded a total of four ancient vessels from the waterfront. Penglai No. 1 and No. 2 date to the Ming dynasty (fig. 15). The vessels have characteristic features of Chinese-built craft, including bulkhead construction and planks joined by diagonally set iron nails. Penglai No. 3 is a hybrid vessel evidencing both Korean and Chinese shipbuilding traditions, while Penglai No. 4 is a Korean vessel.[30] Despite the fact that Penglai No. 3 is to date the only archaeological evidence of a hybrid vessel in Northeast Asia, this discovery suggests that regional shipbuilding traditions may have been fluid in nature. It is plausible to assume that the northern Chinese knew the characteristics of Korean ships.

The Penglai No. 1 and No. 2, discovered twenty years apart, are most likely military vessels used near shores or on rivers. The surviving lengths of both ships are nearly 30 m and the maximum beam of each is about 6 m.[31] Both ships have relatively flat cross-section profiles, but the angles of dead rise increase toward their prows. The keel of each protrudes slightly inside the hull.[32] Planks were joined using square iron nails placed diagonally from inside the hull. Iron nails were also placed within the seams, going through the width of a plank on top and into the next, lower plank. The planks are approximately 20 cm square near midship and narrower toward the turn of the bilge. Bulkheads are connected by mortise and tenon and also with iron nails.[33] The joinery between the bulkhead and the planks for Penglai No. 1 uses L-shaped iron brackets; the bracket was placed from the plank, and the flat surface was nailed to the bulkhead surface. The shorter side of the “L” is imbedded within the seam of the planks (fig. 16).[34]

Nanjing boasts the claim as the birthplace of the Treasure Fleet of

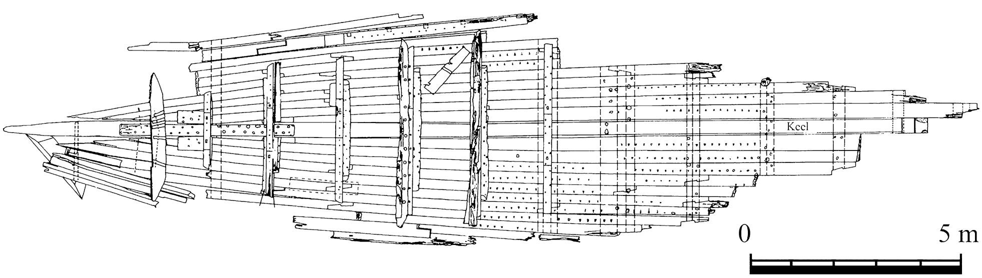

FIGURE 15. Plan View of the Penglai No. 2. Redrawn by author, with modification, after Cultural Relics Bureau of Penglai City 2006, fig. 6–2.

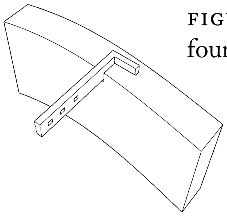

FIGURE 16. Simple drawing of an L-shaped bracket found on the Penglai No. 1. Drawing by author.

the Ming dynasty that sailed the Indian Ocean in the early fifteenth century. Shipyards of the Ming dynasty existed along the Yangtze River; the sites of most of them have been forgotten over the centuries, but a handful have survived. In 2003 and 2004 the Nanjing Municipal Museum conducted a large-scale excavation of one of the three remaining shipyards.[35] Numerous poles and platforms used to construct vessels were found, along with many shapes and sizes of iron nails, wood-working tools, pulley mechanisms, and unused ship timbers. Most of the planks discovered were, however, relatively thin and small. The site did not yield substantial hull remains except for two 10 m long rudder posts.[36]

Another vessel was discovered at a shipyard in Ningbo at the mouth of the Yangtze River. This vessel, dated perhaps twelfth or thirteenth century, has seven bulkheads, a rounded hull with a keel (26 cm sided and 18 cm molded), wales, and two tabernacle steps to hold masts (fig. 17).[37] This 9.3 m long hull provides insights into the shipbuilding practices of the time. As with the Penglai No. 1 and No. 2, the keel protrudes inside the hull. The lowest bulkhead is a curved piece of wood that functioned as a frame, with the bulkhead planks laid on top of it. The Ningbo ship has planks that vary in width from 21 to 42 cm, but the thicknesses are a uniform 6 to 8 cm.[38] Iron nails placed diagonally from outside the hull were the primary means of fastening the hull; mortises and tenons are also used sporadically. The seams of the planks are filled with a mixture of tung oil and lime; this is *chunam*, a paste commonly found on oceangoing vessels from South China. The Ningbo ship was probably an oceangoing vessel, as many of the features, including the dimensions of the planks and the use of tung oil, were shared with the vessels built in Fujian Province, which are discussed below.

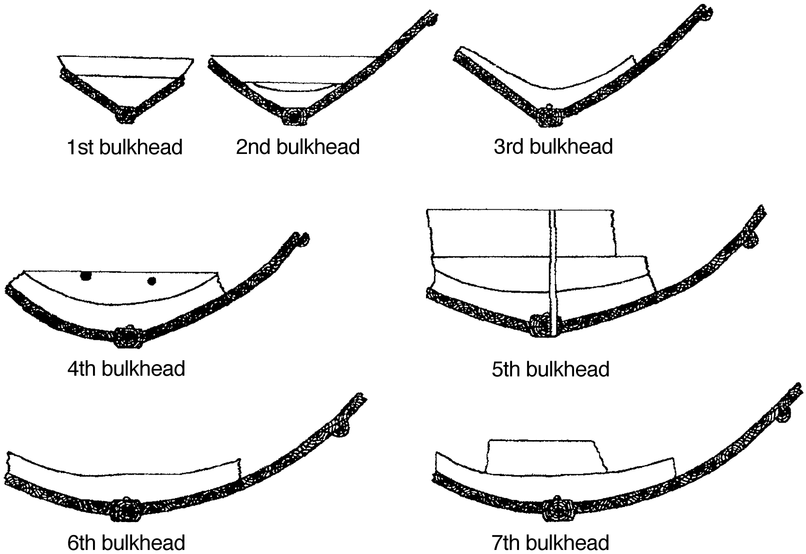

FIGURE 17. Section drawings of bulkheads of the Ningbo ship (from Lin, Genqi, and Green 1991, fig. 12). Reprinted with permission.

FUJIAN SHIPBUILDING

Fujian Province, located directly across from Taiwan, is known for ships built to sail the South China Sea. During the Southern Song dynasty, cities such as Quanzhou became an international centers of trade.[39] Fujian Province was an agrarian society during the Tang dynasty, but by the thirteenth century it had quickly developed into one of the largest port cities in the world, eclipsing the former trading center of Canton.[40] During the Tang dynasty, officials from the central court based in Quanzhou collected large profits, but these officials usually did not invest their profits locally; they used them to enrich themselves. Thus the money did not stay in the province. However, once central control became loose and local revenues for profit-seeking enterprises became available, the province could invest in local development.[41] With this shift, local rulers promoted trade, and by the eleventh century the Chinese were going out to sea in their own vessels.[42] The connection between Southeast Asia and Quanzhou was strong. Muslims from Persia and Arabia were also present. Zhao Rugua reports the existence of a public cemetery for foreigners constructed in the mid-twelfth century by a merchant from Siraf.[43] The historical and archaeological evidence attests to strong foreign connections.

Jung-Pang Lo, a Chinese maritime historian, reports an account from the early Song period that stated that a government official from northern China ordered flat-bottom vessels to be built in the city of Quanzhou for overseas travel; however, the shipwrights from the town refused the order, stating that they would not construct such a vessel because they were not suited for open seas and deeper-hulled vessels should be built instead.[44] This clearly demonstrates the difference in shipbuilding traditions across China, and it implies that the ships from the north were not as seaworthy as the ships from the south, or at least were perceived as such.

Marco Polo, who wrote about the naval organization of China, also wrote about the Chinese ships from Fujian. He mentioned that Chinese vessels had some thirteen compartments and were made with strong planking. He also described the use of lime paste, or *chunam*, the mixture of tree oil and hemp for waterproofing the seams. The practice of layering planks is worth noting; Polo said that with each repair, Chinese shipwrights applied one extra layer of plank and added up to six layers of planks.[45] It seemed impractical to have a vessel with six layers of planks, however. A Chinese maritime archaeological team recently announced the discovery of a wreck, Huaguang No. 1, a large vessel with six layers of planks.[46]

The most famous excavated shipwreck from East Asian waters is the Quanzhou shipwreck of the Southern Song dynasty (fig. 18). The 20 m long vessel has a deep hull and twelve bulkheads. Archaeologists believe that the wreck was a cargo vessel returning from Southeast Asia because of spices, wood, and exotic materials carried on board. The Quanzhou ship's keel is wider than it is tall at 27 cm molded and 42 cm sided.[47] The garboard, larger than the other planks, is firmly attached to the keel. The shipwright who built the Quanzhou ship used iron nails, driven diagonally from outside to join planks, and made the hull with three layers of planking.[48] The L-shaped iron brackets (similar to the ones found on Penglai No. 1) connected the planks and bulkheads. These brackets are set from the opening outside of the plank, going through the thickness of the plank. The longer side of the "L" was nailed to the surface of the bulkhead.[49] The Quanzhou ship was literally painted with *chunam*; every seam and nail hole inside and out was sealed with an ample amount of this substance.[50]

Another famous East Asian large cargo vessel, built possibly in Fujian Province, is the Shinan ship discovered in Korean waters (fig. 19). The cargo from the vessel indicates that this late Yuan dynasty vessel was on its way to Hakata. The ship has a large and wide keel, 50 cm molded and 71 cm sided. The garboards are thicker than other planks and are strongly attached to the keel. The lowest bulkhead timbers are thicker than the other bulkhead planks, acting as a frame. The Shinan ship does not possess the multiple layers of planking of the Quanzhou ship, but its planks are thicker, and it has a thin layer of pine sheathing. The bulkheads and planks are connected with stiff-

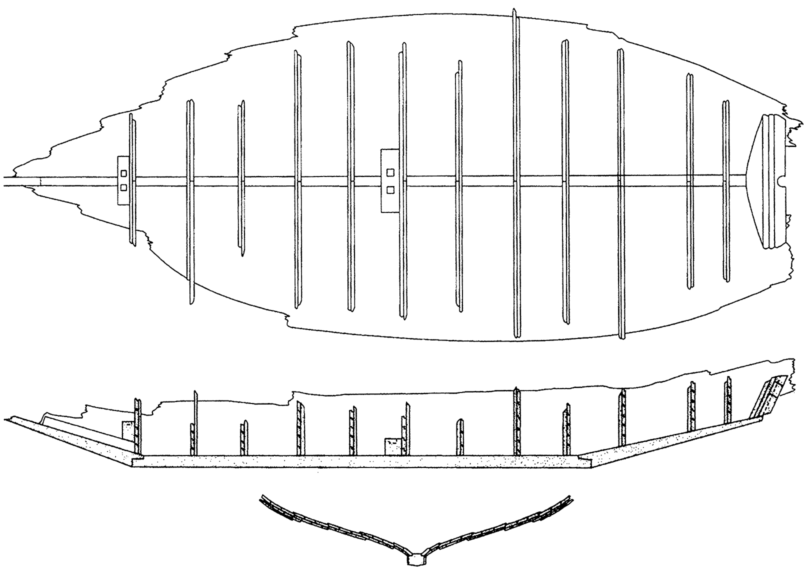

FIGURE 18. Plan of the Quanzhou vessel (from Green, Burningham, and Museum of Overseas Communication History 1998, fig. 5). Reprinted with permission.

FIGURE 19. Shinan ship on display at the National Maritime Museum of Korea, Mokpo. Courtesy of the National Maritime Museum of Korea, photo by author.

eners, or a wooden form of an "iron bracket" like those found on the Quanzhou ship.[51]

Types of Ships Likely Used in the Mongol Invasions of Japan

Various types of evidence, including iconography, historical documents, ethnographic records, and archaeology, provide insights into the types of vessels constructed in East Asia in or around the eleventh to thirteenth centuries. The evidence provides clues as to what kinds of vessels Khubilai might have sent to invade Japan. Using the evidence discussed above, the most likely ships brought to Japan will be considered below.

Historical documents do not speak much about how the Mongols organized the invasion fleet. It is not clear if the fleet was a conglomeration of randomly chosen ship types or if it was purposely composed by different ships with a specific task. Identifying the plan and organization of the invasion is useful for determining the origin and types of vessels that the Mongols used. To decipher the plan, one must study how Khubilai led other campaigns to victory, and his successful methods can be used as a template to deduce his probable plan for the second invasion of Japan. For this, Khubilai's campaigns against Dali, the Song cities, and the first invasion of Japan are worth discussing. Morris Rossabi's research suggests that the Mongols were efficient in tactical battles as well as in their strategic plan of the war in conquering the enemy's land but that the Mongols also realized that "not engaging in a battle" was often the best way to win the war.[52]

The campaign against the city-state of Dali (modern-day Yunnan Province), located southwest of the Song territory, was Khubilai's first major military operation; the success of this campaign made him the most prominent successor for the Mongol throne. The primary reason for invading Dali was to weaken the Southern Song Empire. By taking Dali, Khubilai could cut the important trade that benefited the Song cities and, at the same time, establish strategic positions for launching his army into the interior. Dali, strategically located at the headwater of the Red River, is also a potential highway to invade Vietnam—another important trading partner of the Song dynasty. Khubilai began his Dali campaign plan in July 1252, but did not set out until September of the next year. An important aspect of this long preparation was that Khubilai established military farms for supplying his troops, even creating a specific bureau for this purpose.[53] This shows both his careful planning and calculated strategy. On the surface, it almost seems to be a waste of time to create the needed supplies. Yet Khubilai was successful and came to rule the land. A man with a vision, he did not seek immediate gain but instead studied the overall picture of world conquest and saw managing the empire as his ultimate goal.

The attacks on the Chinese cities also exhibited tactics similar to those Khubilai used in his conquest of Dali. This campaign's success rested on making towns and regions self-sufficient in providing troops and supplies. The Mongols were not always on the attack, and the stereotypical image of always-invading and fierce Mongols must be dismissed. Khubilai used many foreign advisors to rule his empire efficiently, and they often provided the strategies for his battles.[54] Khubilai also cooperated with local populations to topple the Southern Song Empire. At the city of Quanzhou, the superintendent of maritime trade was persuaded by Khubilai to assist in ending Southern Song rule.[55] The Mongols were also quick in adopting military technologies, such as siege weapons, and using them effectively. The power of the Mongols, and Khubilai in particular, was based on flexibility in accepting the tactics most suited for the purpose of the campaign. Khubilai also studied the nature of local populations, available technologies, environments, and other factors that could affect the outcome of a battle. That is how the Mongols, a land-bound population based on the Asian steppes, were able to conquer the maritime empire of Southern Song. Khubilai was able to draw support from the people he was about to conquer, was open to new strategies, and, above all, was quick to learn.

The 1274 invasion of Japan, discussed above, was the first time that the Mongols engaged in an invasion across an open sea.[56] Supplying troops with enough provisions was, in many ways, more important than the operation on land. Nevertheless, the Korean Peninsula is not a fertile land. One year before the invasion of Japan, Khubilai ordered a survey of Korea to determine the number of troops, the amount of grain, and the number of ships that could be used for the expedition.[57] The fifteenth-century Korean document *Goryeo-sa* (高麗史) mentions that three types of vessels were selected for the first invasion.[58] These were 1,000-*liao* vessels, *baator* vessels, and water transport boats. The account noted that 300 vessels were built for each type, totaling 900 vessels. The 1,000-*liao* vessels were transports and built much like a merchant ship.[59] *Baator* is the word for "brave warrior" in Mongolian, and these were most likely landing craft.[60] The water transports can be considered as miscellaneous boats. Khubilai's strategies for these and many other military expeditions demonstrate his emphasis on the efficient organization of troops and the importance of carrying adequate provisions.

All these campaigns organized by Khubilai suggest he was a leader who carefully planned the battle strategy and emphasized the need to provide enough supplies—food for the soldiers. Following the model from the first invasion, the second invading fleet should have been divided into three groups: one group to attack the Japanese forces, the second group to carry needed supplies to the front, and the last group for miscellaneous purposes. Several pieces of circumstantial evidence, which are described below, lead to one answer. The fleet from Korea was the main fighting force while ships built in southern China took supplies to the front, and the rest of the ships from the Yangtze delta acted as a miscellaneous and reconnaissance mission group.

The Korean king had become a close ally of the Mongol Empire.[61] The balance of power was far from being equal; the king had to prove his loyalty to the Mongols. If the invasion was successful, his effort would be rewarded by gaining higher status within the empire. For this reason, the Korean king supported Khubilai's endeavor by building vessels. The past relationship between Korea and Japan had not always been amicable, and it is possible that many Koreans were willing to fight against the Japanese.[62] Despite its willingness to aid in the invasion, however, Korea lacked resources to support troops. The mountainous peninsula did not possess large areas of fertile land required to grow grain to feed a large number of soldiers.[63] Furthermore, since the first Mongols advanced into Korea, the country had been engaged in continuous warfare and its resources were depleted.[64] Korea did not possess large vessels because its coastline, dotted with numerous islands, was complex, and this hindered the development of large vessels. Small, strongly built vessels were better suited to such an environment. For the second invasion, all nine hundred vessels sent out from Korea were simply called "Fighting Ships."[65] These vessels must have been robust, flat-bottom boats typical of those vessels built in Korea, as already illustrated above. Flat-bottom designs were suited for protected inland waters and were best used as a landing craft.

The circumstances of the Southern Song, on the other hand, were quite the opposite. With the Mongol conquest just a few years prior to the second invasion of Japan, a large number of people from the Southern Song region may not have been content with a foreign emperor ruling over them. There was a possibility that a powerful leader could take control of the navy and try to bring native Chinese rule back to China. The navy and army were still functioning, but it was no longer necessary to defend the country from the Mongols who now ruled them. Khubilai did not find it expedient to dismiss soldiers because this would flood the country with a newly unemployed population. A simple solution to these problems was to send Chinese forces to conquer other lands. The former Southern Song territory possessed considerable resources, particularly grain. The delta of the Yangtze River was a rich and fertile landscape and was the main grain-producing region in China.

As seen with the Quanzhou and Shinan ships, Fujian Province was famous for its building of cargo ships, especially V-shaped vessels suited for long voyages.[66] By utilizing its ample resources and wealthy seafaring merchants, the people of the Southern Song had once ruled the sea. The vessels constructed in southern China may not have been as sturdy as their Korean counterparts, for according to a remark reportedly made by Khubilai, "Ships from the Song are big but not strong; Korean ships are small but strong."[67] The people of Southern Song may not have been willing to fight, but they had an ample supply of provisions and other resources, and they possessed large cargo vessels to carry them to the front.

The vessels built along the Yangtze River were probably best used for miscellaneous purposes such as reconnaissance and for transporting materials and soldiers near shore. Vessels from the region had a flat bottom designed to be used on inland waters (fig. 20). It may appear strange to some readers that flat-bottom ships were brought to invade Japan. Riverboats were usually made flat at the bottom so they could be beached, but they could not take a straight course due to the lack of a central keel that lowered the center of gravity and created stability on rough waters. This may be a truism for many, but this statement may not apply to the vessels built in the East. While one might assume that flat-bottom rivercraft suffered on the open ocean, many vessels carried a rudder that could be raised or lowered so the sailors could adjust the center of gravity, allowing the ship to take a straight course even in rough seas. The rudder of a Chinese ship acted as the central focal point that made the ship "grip" at the stern. This is the reason why Chinese (and Korean) ships carried much larger rud-

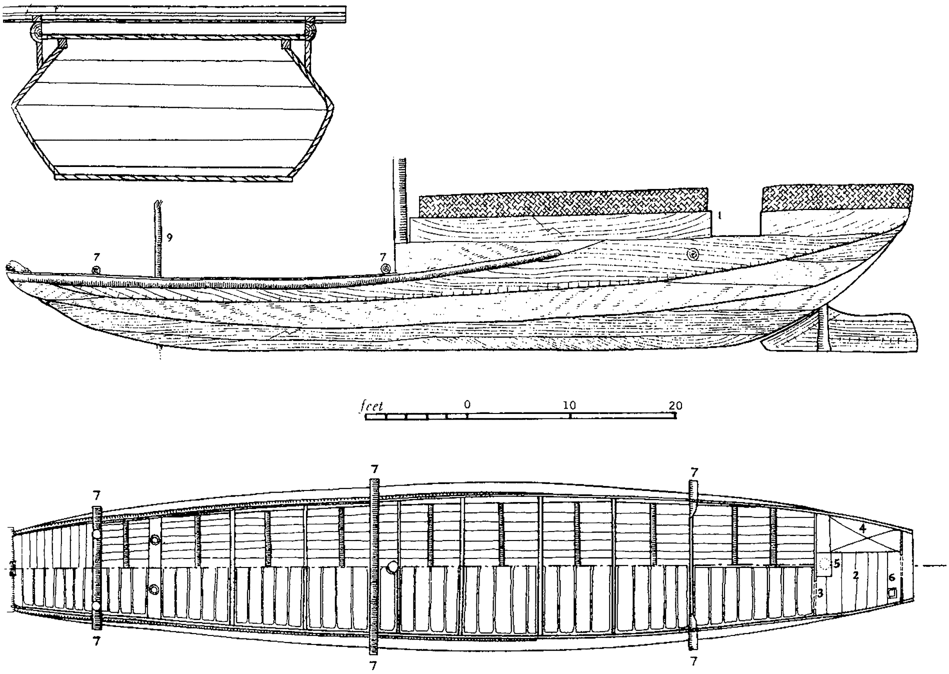

FIGURE 20. Drawing of a traditional flat-bottom vessel from the Yangtze River area (from Worcester 1971, plate 166). Reprinted with permission.

ders than western ships of similar sizes. A flat-bottom ship lowered the rudder when sailing in open sea, and when approaching shore, the rudder was raised. The stem of a Chinese rudder usually had two rectangular openings where a tiller was fitted. This adjusted the height of the tiller for easy operation. Therefore, a flat-bottom boat was well suited to travel in unfamiliar waters. The ships built along the Yangtze River could function either as a supply carrier in relatively deep water or as a landing craft in shallow waters. In addition, such a vessel was also a perfect candidate for reconnaissance—perhaps the most important unit when invading unfamiliar territory by sea.

Along with the circumstances and the ships that they had, the records of the event also reflect the plan of the invasion, for they list the number of ships and troops and the amount of grain that they carried.

These records can be used for reconstructing the general nature of the fleet.[68] One estimate has the Eastern Army at 40,000 troops and 17,029 nonfighting crew on 900 ships, and the Southern Army with 100,000 troops and 42,572 nonfighting crew on 3,400 to 3,600 ships.[69] The number of troops divided by the number of vessels can be used as a rough estimate for the function of the troops. The Eastern Army probably had 45 to 55 persons per ship, and the Southern Army had 30 to 40 persons. The large number of troops on a vessel suggests a unit whose purpose was to carry the main fighting force to the front while the smaller number of people per ship seems too small for this purpose. At first glance, this number does not make sense. Considering that the usual Korean ships at the time were no larger than 20 m and the southern Chinese ships were perhaps 30 m or longer, why would they have a larger number of troops in a smaller ship? However, if the two fleets had different purposes, the small number of people on larger ships could be explained. From the amounts of grain carried, Ōta estimated the quantities of provisions allocated to feed Khubilai's army and concluded that the Eastern Army carried grain to last five to six months while the Southern Army carried thirteen to sixteen months' worth of grain. These numbers reflect the fact that the Eastern Army had an inadequate supply of grain, while the Southern Army had a smaller number of troops but carried more grain and other resources for the operation. Estimates of troop strength can be summarized as follows:

Eastern Army
Estimate by Rossabi (1988):
40,000 Mongol/Chinese soldiers; 25,000 Korean soldiers and sailors; 900 vessels
Estimate by Ōta (1997):
40,000 soldiers; 17,029 Korean sailors; 900 vessels
Southern Army
Estimate by Rossabi (1988):
100,000 soldiers; number of vessels not specified
Estimate by Ōta (1997):
100,000 soldiers; 42,572 sailors; 3,500 vessels

Considering available evidence, one thing becomes clear: the Mongols most likely had a plan, or strategy, in conquering Japan and organized the fleet into units that had specific tasks. Khubilai had to coordinate his troops stationed in different regions, and those units had to work together to achieve the goal. The emphasis on creating a base that can supply the troops appears to have been one of the most important aspects of Khubilai's military strategy. In order to create a foothold in Japan, the Mongols had to analyze the strength and weakness of each ethnic group and region to fully utilize the resources at their disposal. To establish a base of operation, combat troops first had to land on the Japanese homeland and gain control over a piece of land. Once this was achieved, the next unit, consisting of army-farmers, landed and settled.[70] Until the community became self-sufficient, a considerable quantity of provisions would have to be brought in. Thus, logically there should be two main forces—one dedicated to fighting and acquiring territory and the other, the supporting unit, to ensuring an ample supply of grain. To summarize, the Eastern Army consisted of flat-bottom landing ships and troops willing to fight, while the Southern Army consisted of large cargo ships carrying ample supplies and a large number of troops who may not have been willing to fight. Perhaps one large cargo vessel, built in Fujian Province, acted as a central unit that was accompanied with several mid-size and small vessels from the Yangtze estuary. These vessels acted as patrol boats and protected the large cargo vessel. This "one unit" may have consisted of ten to twenty ships. Two hundred such units will add up to 4,000 vessels in total. Although this is still only a hypothesis, available historical documents suggest this may have been the case.

Chapter 4 Artifacts

OVER THE PAST DECADE, various types of artifacts have been discovered at the Takashima underwater site. Many of the objects recovered include ceramics, mainly storage jars, unidentified iron objects, bricks, wooden fragments, and stone balls, which are likely shots thrown from a catapult. It must be noted, however, that most of the artifacts are waiting to be conserved and only a cursory analysis has been conducted. More information will be available once the conservation is completed and detailed studies are made. Obviously, these artifacts from the site require analysis by specialists in ceramics, weapons, personal items, and ships, for example. As a specialist in East Asian shipbuilding myself, this book focuses on those artifacts that were parts of the ships. But working with the reports of my colleagues in Japan, I provide in this chapter a brief description of some of the artifacts discovered at Takashima to help illustrate the story of the invasion. For those who are interested in more details, a preliminary catalogue of all the artifacts, some of which are illustrated, is contained in the site reports published by the Takashima Board of Education and the Matsuura Board of Education.[1]

Almost all artifacts illustrated here were excavated in 2000 and later seasons from Kōzaki Harbor; they are divided into the following five categories: (1) ceramic remains; (2) bronze/cuprous objects; (3) iron objects; (4) lacquered artifacts; and (5) miscellaneous artifacts. The ceramic remains include porcelain, celadon, and fired clay storage jars. The bronze/cuprous objects are mainly decorative small items such as belt and sword buckles as well as coins. Most of the weapons found at Takashima were made of iron. While lacquered artifacts were not common, many of them had inscriptions and are worth further discussion. The miscellaneous category includes *tetsu-hau* (bombs), bricks, organic remains, and personal items.

Ceramic Finds

The ceramic assemblage at the Takashima underwater site is mainly limited to containers for storing food, water, and other goods (fig. 21). The large majority of the ceramics are small fragments and analysis is ongoing. Only a handful of ceramics were found complete, and other less fragmentary ones have been reassembled. Descriptions for only the nearly complete artifacts will be provided here. A quick glance of the assemblage indicates that most of the ceramics were utilitarian wares. There were several unique finds, including a water jar with spout and handle, a possible plate reused as an oil lamp, and a cup or small vase. Approximately eight out of ten ceramic artifacts are storage jars. The rest are bowls and plates used for feeding the troops. The main types of ceramics represented are White Porcelain; Longquan Kiln Ware; Jun Kiln Ware, Korean Celadon, and Fujian Celadon (Chinese celadon made in Fujian Province).

White Porcelain: Nine White Porcelain bowls were found at Takashima (fig. 22). The clay of the bowls is grayish in color with some black impurities. The glaze is mainly dull and gray compared to porcelains of the export type. A typical bowl is about 7 cm in height, with a 16 cm lip diameter and 6 cm base diameter. Two White Porcelain plates were found, and these were of better quality than the bowls. The clay is of a different quality with a yellow hue. The glaze is thin and the bases are unglazed. The heights of these plates are about 4 cm. One plate is without a raised base.

Longquan Kiln Ware: A total of eight celadon bowls and saucers from the famous Longquan Kiln in Zhejiang Province were discovered. The clay is mainly pale brownish in color, and the glaze is a typical olive color. One bowl in particular appears to have been made with poor craftsmanship. Two bowls have a flower relief decoration at their bottom, which is typical of the Longquan celadon wares. The height of the bowls is approximately 7 cm, and the rim diameter varies from

FIGURE 21. Selected ceramic artifacts from Takashima. a, Fujian porcelain bowl; b, Longqun Kiln small plate/saucer; c and d, Shijiko storage jars. Courtesy of Matsuura Board of Education.

16 to 18 cm. The bases are thicker, and base diameters are 6 and 7 cm. The saucer has a shorter height, larger diameter, and its lip is flat. Only one saucer has sufficiently survived to provide dimensions. The clay is pale gray and the glaze is green with a blue hue that was thickly applied. This particular ware is well made, and the glaze is still shiny. No decoration was applied outside, but it has a flower relief in the bottom at the center. It is 5.2 cm high, the rim is 21.4 cm in diameter, and the base is 10 cm in diameter. The small bowl is about 4 cm in height and 8 cm in diameter. It is not well made; the clay is thick, and the glaze was applied unevenly.

Jun Kiln Ware: Four large bowls are identified as coming from the

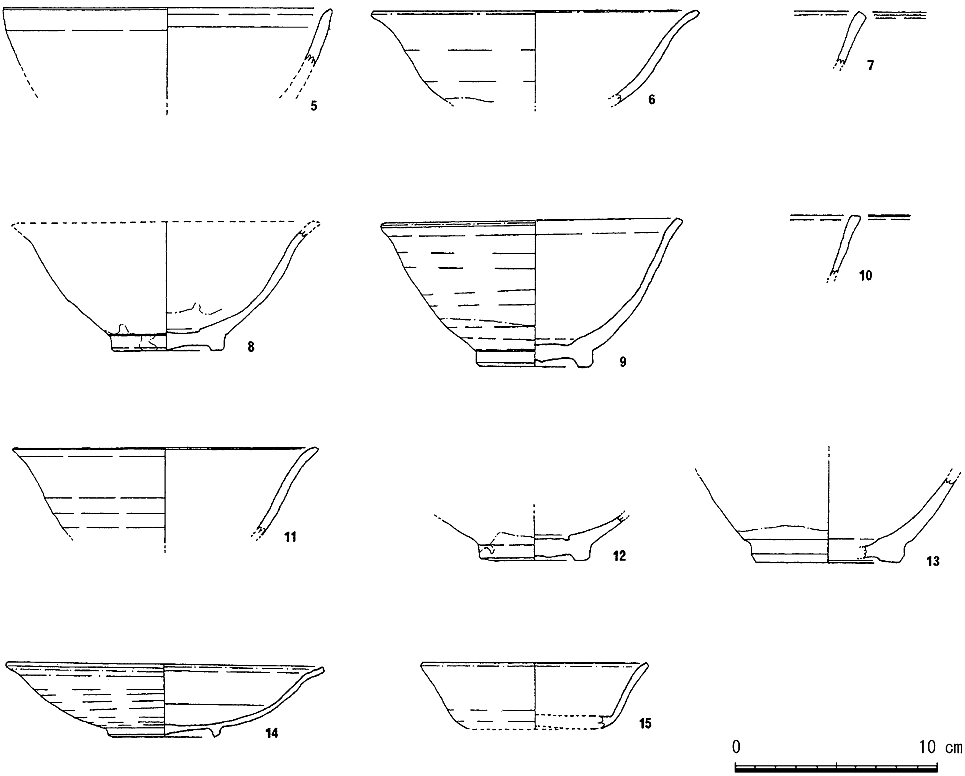

FIGURE 22. Drawings of White Porcelain artifacts (after Matsuura Board of Education 2008, fig. 21). Reprinted with permission.

Jun Kiln in Henan Province. The clay is pale gray in color, and some bowls have impurities but were otherwise made with excellent clay. The glaze is purple, and traces of a white-blue and yellow hue can be seen on some bowls. The glaze was applied thick and to the tip of the base. Jun bowls appear more rounded in appearance than the bowls made elsewhere. The height varies from 6 to 8 cm and the rim diameter from 14 to 18.5 cm. Overall, the Jun Kiln bowls found at Takashima were made with good-quality clay, glaze, and craftsmanship.

Korean Celadon: A small bowl that is possibly Korean Celadon ware was recovered. The clay contains sand particles and has a pale orange color. The glaze has a dull, pale, yellowish-green color. The glaze is thin and was applied unevenly. This bowl is not complete, but it is taller than 5 cm, having a lip diameter of approximately 14 cm. Compared to Korean Celadon found elsewhere, this sample seems to be of lower quality.

Fujian Celadon: A majority of the ceramics can be classified into this group. The exact kiln locations are not determined, but it appears that these were utilitarian wares made for local consumers in China. Close to twenty nearly complete bowls, and the majority of recovered ceramic fragments, are classified as part of this group. The clay of these bowls is pale gray to gray with a yellow hue. The glaze is gray or gray-yellow, and it appears dull. The glaze was applied only on the inside and the top half of the outside. The shape of the lips and the bases reveal slight variations among the bowls. A typical bowl is about 10 cm in height and 17 to 18 cm in lip diameter. Some bowls have an incised design. Two of the bowls have ink inscriptions. One is faded and could not be deciphered. The other bowl has the inscription "*wang bai-hu*" (王百戸) written on its outside surface (fig. 23). The word *bai* stands for "one hundred" and *hu* denotes a military unit. The suggested translation is "Wang, the Centurion," which would indicate this was a personal bowl reserved for the use of an officer. Mongols organized their units based on the decimal system, and this artifact is evidence of Chinese integration into the Mongol military system.

Storage Jars: Approximately 80 percent of the total number of ceramics is storage jars. These vessels come in many different types. The shapes and sizes vary and show that they were made in different kilns. Most of the storage jars are classified as *shijiko*, a storage jar with four lugs, perhaps made in kilns in Jiangsu Province, just north of the Yangtze River. Some were made in kilns from Fujian Province. The jars with four lugs can be roughly divided into two groups: a globular type and an elongated type. The globular type has a lip opening diameter of 7 cm, a maximum diameter of 17 to 18 cm, and a height of no more than 25 cm. The elongated type has the lip opening of 5.5 to 7 cm, and the maximum diameter varies from 11.5 to 15 cm. The heights of the elongated four-lug storage jars are roughly

FIGURE 23. A Fujian bowl with the inscription "*wang bai-hu*." Courtesy of Matsuura Board of Education.

30 cm, but some are slightly taller. No analysis was conducted for contents because it is believed they came from an area of the site that was heavily disturbed, and hence no organic material was thought to be present.

Bronze/Cuprous Objects

The majority of the bronze/cuprous artifacts can be classified into an armor/weapons assemblage. There are also utilitarian tools, utensils, decorative pieces, and coins. The large majority of the cuprous artifacts are belt or sword buckles and small decorative pieces. These decorative elements range from 3 to 10 cm in maximum dimension and are mainly flat manufactured pieces, but some of them are rounded in cross section. More elaborate ornaments were possibly used to decorate furniture or other objects. Bronze spoons are also represented; these are about 20 cm in length, with a handle width of 1 cm and a bowl about 6 cm long and 3.2 cm wide. It is 2 mm thin at the bowl but becomes thicker toward the handle. Two of the spoons have a small aperture at the handle where a ring was attached. A possible bronze cooking ware was also found but was badly damaged. This is the largest bronze object found at the site. It has a diameter of 15 cm and a thickness of 1 to 2 mm. Small bells and small bronze mirrors were also found. Most of the other bronze/cuprous artifacts found were decorative pieces and were not particularly diagnostic. In addition, many of the objects are small and fragmented. Coins, however, were the most diagnostic of all the metal artifacts recovered from the Takashima underwater site.

Coins were important trade goods in East Asia. The Southern Song dynasty used copper coins, but it was also a time when China was adopting paper currency. Chinese coins were widely circulated in Japan during this period. The Takashima underwater site initially yielded ten coins that could be dated with certainty, and a large cache of eighty-eight coins was discovered in late 2002 (fig. 24).[2] The oldest coin discovered is a *Kai Yuan Tong Bao* (開元通寶), first minted in 621 CE during the Tang dynasty. This particular coin was extensively minted and widely distributed. It must be noted that the price of coin in China was not based on the raw material, but was arbitrarily set by the ruling dynasty, while other Asian nations based the value of the coins on the raw material.[3] Thus, outdated coins were popular export items because Chinese merchants could sell them abroad with a much higher exchange rate than in China. For this reason, it is not rare to find an extremely old coin, as seen in the example of the Shinan ship, where a coin from first century CE was discovered from a shipwreck more than a thousand years apart.[4] Another interesting coin is a *Zheng Long Yuan Bao* (正隆元寶), first minted in 1157 CE. This coin is from the Jin dynasty of northern China. The rest of the coins were all from the Northern Song dynasty. Three coins, with inscriptions reading "*Fu Lu Shou Chang*" (福録壽昌), were also discov-

FIGURE 24. Strings of Chinese coins discovered at Takashima. Courtesy of Matsuura Board of Education.

ered. These were not coins that circulated but rather were used as an amulet, or a good-luck charm. The eighty-eight coins that were found together appear to be the same type, although many of them are degraded and cannot be deciphered. Those that can be deciphered are all *Tai Ping Tong Bao* (太平通寶), a coin first minted in 976 CE during the Northern Song dynasty.[5] Despite the one cache of coins, the number of coins discovered appears small in comparison with those of other East Asian shipwrecks, but the other wrecks were merchant ships. It probably made no sense to bring a horde of coins to the battle. The presence of coins from the Jin dynasty suggests that those who brought the coins were from northern China, perhaps an officer who thought of doing business aside from the battle.

Iron Objects

Iron is not a stable metal, and when it is exposed to seawater for a long period of time, the element of iron (Fe) leaches out and creates what is known as a "concretion." This is a hardened substance that will form around the original metal, incorporating sand, shells, and other materials that surrounded the iron object. The concreted artifacts are often hollow inside, making a mold of the original object. Sometimes they also leave a heavily oxidized layer within the mold. The concretion often looks nothing like the original artifacts, and accurate interpretation of the artifacts has to wait until the conservation process is complete. The conservation effort at Takashima has just begun, and the process is slow because it requires specialized training to conserve iron. Therefore, the interpretation presented here is no more than a preliminary observation. The majority of the iron objects found at Takashima were of iron nails from ships as well as weapons and armor. Some small utilitarian objects were also found.

There were a dozen or more "possible" swords, but only four survived enough to confidently identify them as swords (fig. 25). Among the four, three had a straight blade while one had a slightly curved blade. One sword is 86 cm in total length, with the blade alone measuring 62 cm. The width of the blade is 5 cm, with a maximum thickness of 8 mm. The hilt is 3 cm wide and approximately 1 cm thick, but most likely was decorated. The end is equipped with a ring. Another similar sword has a 63 cm long blade and a 15 cm hilt. This sword also has a ring at the pommel, but the hole is rectangular compared with the rounded ring of the first sword described. The hilt of the third straight sword is missing, but the blade has survived in its entirety. The blade is 70 cm long and has a width of 5 cm. The thickness could not be observed because of its degraded nature. According to Chris Hanson, these types of swords, which had a ring at the hilt, was mass-produced in the tens of thousands in southern China.[6] The last sword to be described, a curved sword, is 95 cm long. The blade is 5 cm wide near the hilt and becomes narrower toward the tip of the blade. Other possible swords, of which only a small section has survived, if they were swords, have a blade width of 3 to 5 cm.

Five well-preserved iron helmets were also discovered along with many possible fragments. The diameter of these helmets is 22 to 23 cm, and their height is 12 to 15 cm. A few helmets appear to be thicker at one end. All of the helmets seem to have had an attachment at the top where a pointed protrusion was located.

A handful of bundled iron-tipped arrows have also been discovered (fig. 26). Bundles of 50 to 60 arrows appear to have been placed in bags to be carried by soldiers. The surviving wood of the arrows was lacquered and is very fragile. The iron tips are approximately 15 cm, with a width of 1 to 1.5 cm. Several types of tips were observed. The conservation of the arrow bundles is extremely difficult because of the composite nature of the artifacts, and they are currently being treated. A CT scan analysis of one of the bundles showed small iron tools inside. In addition, some buckles and other small objects have been found associated with these bundles. Perhaps these small tools

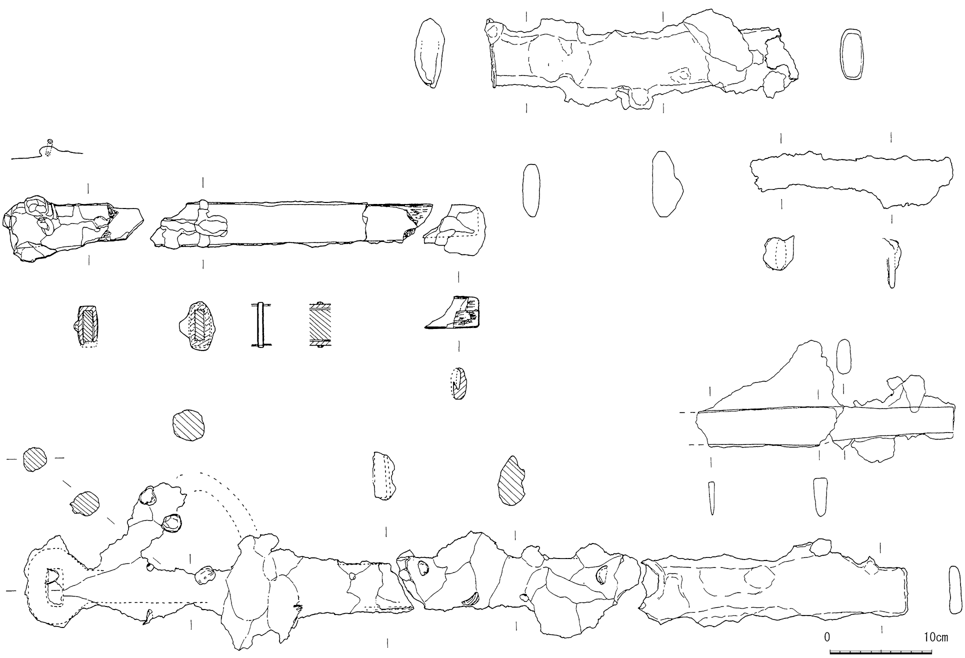

FIGURE 25. Drawings of swords (with concretion) from Takashima (after Matsuura Board of Education 2008, fig. 55). Reprinted with permission.

FIGURE 26. Bundle of arrows. Courtesy of Matsuura Board of Education, photo by author.

were used to adjust the tension of the bow or to repair it. Several chain fragments were found, and most of them have a diameter of 12 cm or less. Possible wood-working tools and a shovel were also recovered. One possible shovel is approximately 20 cm broad. The presence of a possible shovel seems to suggest that the Mongols were equipping their troops with some land-working tools, perhaps to establish a shoreside base of operation.

Lacquer Artifacts

Lacquer artifacts are usually rare in archaeological contexts because of their fragile nature. Lacquer is applied on wood or leather; most often the base material is no longer present, and only the lacquer on the surface has survived. Thus the identity of many artifacts cannot be known. However, one important aspect of the lacquer artifacts is that many of them retain inscriptions that give archaeologists and historians excellent clues about revealing the mysteries of the invasion. One written tag is especially important. A layer of black lacquer was applied on the tag, and words were written with red lacquer. Unfortunately, the wood has been lost, leaving only a thin layer of lacquer with the inscription. A stylized signature, or *Huaya* (花押), is also inscribed. The tag reads, ". . . *Yuan-nian-dian-si-xiu-jian-shi-qi-guan*" (元年殿司修検視訖官). This can be translated as "in the first year of . . . , [name of an official] inspected, repaired, and approved . . ." The presence of this tag proves that "something" was approved by a government official for the preparation; however, it is not known what was repaired and approved. The significance of this discovery is further explained later in this book.

Several fragments of lacquered bows were found. The surviving length varies from 4 to 20 cm. The tip, where the string was attached, is of triangular shape and the cross section becomes square toward the center of the bow, where the thickness and width are about 1.3 cm. The bow has a notch 3 cm from the tip where the string was placed. The notch is 5 mm wide and 5 to 8 mm deep. A possible crossbow fragment was also found. The timber has an upside-down keyhole shape in cross section, and on its top side (flat side), there is a 1 cm groove. Lacquer was applied on this groove where the arrow is believed to have been placed. Nail attachments and a mortise can be observed where this central piece was affixed to other components of a crossbow. Several other unidentified pieces of wood with lacquer were also found. Another type of artifact, numerous fragments of lamellar armor were found. This type of armor was made by layering small scales of leather with lacquer. Most of the leather has disintegrated, and only the lacquer has survived.

Personal lacquer items were also found at the site, including five combs and three bowls. These combs averaged 10 cm in width and 5 to 6 cm in height. Thickness varied from 0.8 to 1.1 cm, and some are rounded at the handle end. The teeth are set 2 mm apart. The bowls had black lacquer applied first, followed by a red lacquer layer on top. The bottom of each bowl was left black, but all bowl bottoms also had red lacquer inscriptions. The most complete lacquer bowl measures 19 cm in diameter with a height of 7 cm. It has the signature, *Huaya* (花押), at the bottom and a possible name, *Zhang* (張), also written in scored lines. This may have been a personal bowl of an officer, a certain person named Zhang—which is one of the most common family names in modern China. Only the base has survived of the other two bowls. The diameters of the bases are 6 and 8 cm. The one bowl reads "*Xinyou-si-ming-chu-er-lang-zao*" (辛酉四明諸二郎造), which is an inscription recording the year, location, and the name of the person who made it. The bowl was made in the year of *Xinyou* (辛酉), most likely 1261 CE. The Chinese calendar is based on the twelve-year cycle of earthly branch, which gives the zodiac animal designation to the year, combined with the ten-year cycle of heavenly branch. Combined with the two branch systems, working like a gear, the calendar makes one full cycle every sixty years. Thus, it is possible that the bowl was made in the year 1201 or 1321, but it is unlikely considering the archaeological context. The third bowl is heavily damaged and conservators cannot read much of the inscription, but again it states the year, location, and name of its manufacturer. The words that can be identified are *geng* (庚) and *Nan* (南). *Geng* refers to the heavenly stem of the branch. Thus, it can be 1260, 1270, or 1280. *Nan* means "south," perhaps referring to a location.

Miscellaneous Artifacts

Tetsuhau: Among the more interesting finds are the previously mentioned *tetsuhau*, or ceramic bombs (fig. 27). This is the earliest archaeological evidence of shipboard explosive ordnance found from any battle site in the world. Among twenty-one large fragments discovered so far at Takashima, three of these stoneware "bombs" are nearly complete. The bombs were packed with scrap iron, and there was possibly gunpowder inside, but trace element analysis has not yet been completed to confirm the presence of gunpowder. Given the nature of the site and the illustration of one of these bombs exploding in one panel of the *Mōko Shūrai Ekotoba* scroll, it is hard to believe that these "ceramic balls" were anything other than *tetsuhau*. On average, *testuhau* from Takashima are 13 cm in height and 15 cm in diameter. They are nearly spherical, with a flattened bottom to allow ease of storage and to prevent being rolled over and accidentally detonated. The ball was made using the coil pot technique, and the surface was finished on a potter's wheel, but not made smooth. The clay

FIGURE 27. *Tetsuhau* found at Takashima and displayed at the Folklore and Archaeology Museum in Takashima. Courtesy of Matsuura Board of Education, photo by author.

is thicker at the bottom, about 3 cm, and becomes thinner at the top, about 1 cm in thickness; another method for ensuring that the ball would not roll accidentally. An opening at the top is where the fuse was placed. This opening for most samples is about 3 cm in diameter while the largest is 6 cm; the average diameter of this fuse aperture is 4.5 cm. The clay contains a large number of impurities and was fired at a low temperature, which left rough surfaces. To deploy these weapons, the fuse was lit and the ball was thrown by a catapult. When the bomb exploded, the scrap iron packed inside acted as shrapnel to kill or most likely to wound. *Tetsuhaus* reportedly made a large noise and emitted bright fire, according to the *Mōko Shūrai Ekotoba* scroll.[7] It was a type of weapon that none of the defending samurai could have imagined; together with the loud noise, the scrap metal cut and pierced their armor.

Bricks: The 128 bricks identified at Takashima can be divided into three groups. The first group averages 8 cm in width and 6 cm in thickness. The estimated weight is around 1 kg. This first group is most numerous at the site. The second group is 15 cm in width and about 5 to 6 cm in thickness. Its estimated weight is up to 2 kg. The third group is 10 to 15 cm in width and the thickness is between 3 to 4.5 cm. Some bricks from this group may weigh up to 2.5 kg. Some of the bricks are charred and it is believed that these are from cooking stoves from ship galleys and also may have been used as balast.

Organic Remains: Considering the heavily disturbed nature of the site, it was surprising to find organic remains at Takashima. The number and variety of organic remains are limited; however, they give a more complete picture of the invasion. Most of the organic remains are still waiting to be conserved and detailed analysis yet to be conducted. The organic remains range from burnt grain, ropes, and textile. Bones of animals, including a horse, and broken human bones and a skull were found. The human remains were found in close association with the lamellar armor fragments and one helmet.

Personal Items: A small statue of a tiger made of white jade was recovered from Takashima. It is 3.3 cm high, 2.7 cm wide, and 1.3 cm thick. It weighs 16 g. A similar green jade statue was also found. This second jade artifact is evidence of high craftsmanship. A male and female deer under a tree is carved on the front and back sides. It is 3.45 cm high, 3.6 cm wide, and 1.8 cm thick. Two stone ink slabs were found at the site. Although these were well made, there is no decoration on their surfaces, and they are simple utilitarian items. One ink slab is 11.15 cm by 7.2 cm, with a thickness of 2.3 cm and a weight of 338 g. The second slab is 4.7 cm by 7.3 cm. It is 1.3 cm in thickness and 93 g in weight. Two tools made from an antler were also found. Both are about 15 cm in length. The purpose of these tools is not known. The last artifact noted here is a small wooden statue of a bald man sitting under a tree, perhaps evoking the Buddha. The artist who carved this had an artistic sense; it used naturally curved wood as a tree represented in the statue (fig. 28). The human figure also shows detailed craftsmanship; however, his lower body is roughly carved, leaving most of the natural wood. It has a small hole to the side and

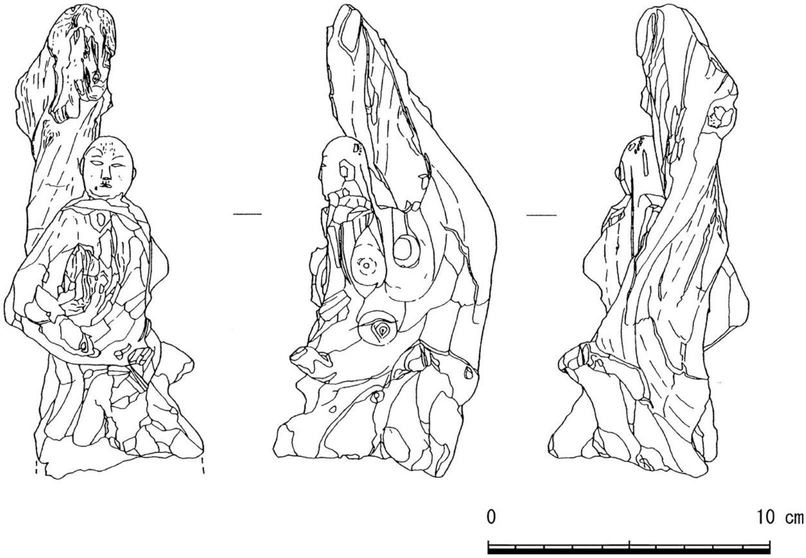

FIGURE 28. Drawing of a wooden statue from Takashima (after Matsuura Board of Education 2008, fig. 67). Reprinted with permission.

perhaps was suspended from a rope or was part of a larger decorative piece. It is 16.5 cm high.

Summary of Artifacts Discovered

As seen above, various types of artifacts were discovered at Takashima. It will take several more years before conservation and detailed analysis of each artifact is complete. However, there is currently enough information to allow for a partial reconstruction of the naval organization of the invading fleet from this approach.

Ceramics, because of their ubiquitous presence in East Asian archaeological sites, are well studied, and comparative materials are readily available. To summarize, the ceramic assemblage from Takashima can be divided into two groups: storage jars and dishware used by the troops. The storage jars are represented by varieties in sizes, but they were mainly made at the mouth of the Yangtze River area and Fujian Province, where historical accounts indicate most of the Khan's invasion ships were built.[8] These containers were small, perhaps packed for water and grain for individual consumption, and were made for easy transportation. The Longquan bowl and saucers come from a kiln known for exceptional high quality and skilled craftsmanship, but the ones from Takashima are of a different and lower grade. This does not denote that these wares were hastily made and gathered for the invasion. Some of the artifacts, such as large bowls from Jun Kiln, are made of good quality. This simply indicates that there were different classes among the troops. The officers, perhaps Mongols and northern Chinese, used celadon of higher grades, and a variety of these wares were found. Common troops, used cheaper celadon bowls made in Fujian Province. This can be seen from the fact that most of the utilitarian wares from Takashima are simple rice bowls for everyday use. The Fujian origin of the bowls may indicate that the common troops were from that area, as were their ships. The presence of Korean celadon is an interesting side note. It is known from historical accounts that the Chinese fleet received the majority of the damage from the storm that ended the invasion, while most of the Korean ships were saved. One would therefore expect to see a lesser number of Korean artifacts, and this appears to be the case here.

The bronze/cuprous objects discovered were mainly small artifacts, and many of the buckles are Chinese in origin. The majority of the coins were from northern China, including Jin dynasty coins. The iron objects, once conservation is over, will reveal more about the weaponry that the Mongols brought as well as possible tools used by farmer-soldiers. The inscriptions on the lacquer wares, with the names of people on them, have provided a unique opportunity to connect to the past as well as to know the nature of the preparation process for the invasion, with the tag explaining the inspection and approval of the unnamed item. In conclusion, there are numerous other small objects that need to be studied separately and carefully. Eventually, a more detailed story of the second Mongol invasion can be reconstructed based on the analysis of these artifacts.

Chapter 5 Timber Category Database

THE WOODEN ARTIFACTS are the most prominent types of artifacts from the Takashima underwater site. A total of 502 timbers were recorded for this project, and this represents the majority of the timber remains excavated from Kōzaki Harbor between 2000 and 2004. To glean information from these hull fragments, a systematic method had to be developed. One of the methods was to organize these timbers into a database based on original function, or where it belonged in the hull. These categories include beams, bulkheads, thin planks, hull planks, railings, fashioned timbers, wales, fasteners, miscellaneous components, logs and cut logs, unidentifiable, and featureless timbers. In this chapter, the criteria for assigning each category are discussed first, followed by the discussion of the finds with a few selected examples. For details about the timbers in each category, see appendix B.

Takashima Timber Categories

World-renowned ship reconstruction expert J. Richard Steffy defines a beam as “a timber mounted athwartship to support decks and provide lateral strength.”[1] A beam is typically a long component that is rectangular or square-shaped in cross section, and only a small number of nails, if any, are present. A beam should be standing free, for the most part, and independent from other components within a hull except a stanchion. Nails found along the length mean the timber cannot be a beam, as this implies that it was attached along another component.

The bulkhead is one of the most characteristic and prominent features of the Chinese shipbuilding tradition.[2] Almost all excavated ships from China dating from the Northern Song dynasty and later have bulkheads. It is a major component and one of the largest timber elements of the hull. Bulkheads provide lateral support to the vessel, like beams; however, at the same time, they compartmentalize the hull. A bulkhead plank should have nails at the top and bottom, connecting to other bulkhead planks. The lateral sides where it connects to the hull planking should have traces of joinery as well. The side of the bulkhead may be at an angle representing the curve of the hull.

A number of timbers discovered at Takashima had a plank-like appearance but were extremely thin. These timbers having a thickness of less than 3 cm were put into a "thin plank" category, separate from the "hull plank" category. It is difficult to say with certainty how these timbers functioned originally. Some of these planks may be from wooden containers or other large shipboard objects. Another possibility is that these thin wooden planks were sheathing or sacrificial planks attached to the outer hull.

It was not easy to define the plank category because a plank-like timber may be either from a bulkhead or the hull. Defining characteristics are needed to distinguish the two. Shipwrights in China usually used diagonally placed nails to connect the hull planking. Archaeological evidence suggests that the common practice was to place nails from only one side for hull planking, while nails were used from both sides to connect the bulkhead planks.[3] Thus, the plank category includes timbers having a general plank-like shape and nails placed only on one side.

A railing is defined as a timber having a thickness less than three times the width. These timbers were used to support larger planks or other components, much like the two-by-fours used in modern carpentry. The function of a railing was to attach two or more hull elements together to give strength to the component. Railings were used like small frames, perhaps for a small vessel, or structures, or a part of large equipment. The function of railings differed piece by piece, and they were not a major component of a hull. Most of the timbers from this category may not be from a hull.

The archaeological evidence of excavated vessels as well as records of traditional shipbuilding indicate that traditional Korean vessels were built using complex, carved wood joinery without iron nails.[4] On the other hand, Chinese shipwrights used iron nails extensively to build a hull. Thus, a timber having a nail was not considered a part of a vessel that originated in Korea. On the other hand, a large timber without nails has a higher chance of having originated in Korea. The fashion timber category was created to identify possible hull fragments from Korean ships. A timber from this category has a maximum dimension larger than 50 cm and lacks any trace of nails. While it is an arbitrary value, 50 cm seems to be a sufficient span on a surviving length of timber to suggest that nails were not used.

A wale is a thicker plank, usually a split log, attached to the outside of the hull to provide longitudinal strength for a vessel. Wales can be seen on many ships depicted in ethnographic records from China.[5] Wales are one of the characteristic features of a Chinese vessel, which typically have a gentle curving hull and no keel, thus needing additional longitudinal support.

Fasteners are wooden elements utilized to connect other components. These include tenons, treenails, dowels, and other such elements. Koreans used complex wooden joinery, and the use of wooden fasteners (treenails) was common.[6]

The miscellaneous components category includes timbers that were relatively well preserved but cannot be included in the categories described above. Some of the timbers may have been part of a frame, mast step, a windlass, or other ship parts. Unique features can be found on all items in this category, such as the presence of joinery and other evidence of human modification or use attributable to a specific purpose. The functions of many of the timbers are still unknown. In theory, the real function of all artifacts in this category could be found through rigorous research. Once research on East Asian shipbuilding technology progresses, timbers from this category may attain more significance.

Not all wooden artifacts were hull components. The miscellaneous components include wood that retains a natural, rounded surface and is limited to 9 to 10 cm in diameter. These timbers have no nails, carved joinery, or a worked surface. Some of these may be simple driftwood. A close examination of some of these timbers, however, revealed straight cut ends, indicating that they may have been utilized for a specific purpose. The cut required an explanation, and the most logical assumption is that these pieces were firewood. All timbers with round driftwood-like features were isolated. These pieces were then divided into two categories: logs and cut logs. Uncut wood may be driftwood, broken firewood, or wood meant to be used for another purpose such as shore-side construction of fortifications. Although artifacts from these categories were not hull components, they made up a large portion of the total number of timbers.

The unidentifiable category includes those timbers having no diagnostic features to reveal how they functioned. In other words, these fragments show traces of nails, other joinery, or modified surfaces, but one cannot tell from where in the vessel they came. An example of a timber in the unidentifiable timber category is degraded wood with one nail or a timber that is a square in cross section without any other diagnostic features. These timbers may have been part of a larger component; however, unlike timbers in the miscellaneous component category, the original function of the particular artifact cannot be identified despite the fact that the timber shows some use.

The featureless timber category is, as the name suggests, composed of those wooden pieces having no archaeological significance other than the fact that they were excavated from the site. These are pieces of wood that have no joinery and no modified surfaces. Further investigation of these timbers will not likely produce information regarding the origin of the vessels.

BEAMS

Thirteen timbers from Takashima fit the beam category described above. This category represents 2.59 percent of the total timbers found at the site. The average rank is 2.85.[7] Only one timber is assigned to rank 1. All items were 50 cm or longer, and five were longer than 80 cm; the average length for a timber in this category is 74.46 cm. The average width is 8.96 cm, and the average thickness is 6.27 cm.

Except for three timbers that had square cross sections, the width-to-thickness ratio showed small variations with an average of 1.64.

Identifying the origin of the vessels from the study of the beam category is a difficult task; however, beams are not commonly used for Chinese shipbuilding. Bulkheads are usually used to provide sufficient strength to the hull. One vessel that may provide a relevant comparison is the small flat-bottomed Yuanmengkou boat from North China.[8] This vessel had multiple beams of natural wood to support the hull. The beams of the Yuanmengkou vessel were 10 to 17 cm thick and 13 to 20 cm wide.[9] From Takashima, only one timber from the beam category had both width and thickness larger than 10 cm. Therefore, it does not seem that the timbers from Takashima were from a large vessel if these timbers were indeed used as beams.[10]

The use of beams is a hallmark of traditional Korean vessels, and one would expect some of the beams found at Takashima to be of Korean origin. As seen on the Wando ship and other Korean shipwrecks, the beams on Korean vessels were often thicker and wider than 10 cm.[11] Thus, the timbers from the beam category may not be beams after all. They may be from a large piece of equipment or from superstructures. A more likely interpretation for the Takashima beam timbers is that these were *jangsak* from Korean vessels. As previously noted, Korean vessels, including the traditional boats, used internal fasteners known as a *jangsak* to lock the bottom planks together (fig. 29).[12] The dimensions of *jangsaks* vary from ship to ship, but they are roughly 5 by 10 cm, similar to the dimensions of the timbers in this category. Although timbers from the beam category are all similar in shape and size, there are no diagnostic features that can definitively identify any as definite beams or as *jangsaks*. More detailed discussion of these timbers follows.

Artifact No. 959: This is the most complete timber within the beam category. Its surviving length is 82 cm. One end is 9 by 9 cm square in cross section, and it is stepped down to a cross section of 6 by 9 cm at the smaller end, which may have been broken or snapped, leaving a clean cut. The change in shape suggests something was hooked to one end, perhaps to fit in a notched section of a hull. No trace of iron nails was found on this timber. Based on the shape and dimensions,

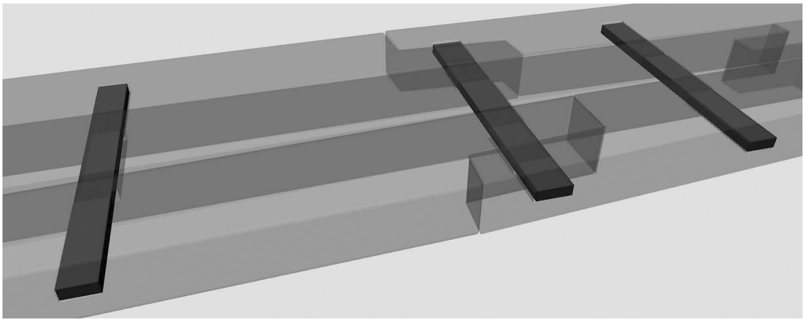

FIGURE 29. Reconstructed model showing *jangsak*. Drawing by author.

this beam must have come from a small vessel and could not have been a major component of a larger vessel. This timber cannot be a *jangsak* because of the step feature; all known *jangsaks* had a straight rectangular shape.

Artifact No. 2004–25: The surviving length of this timber is 64 cm, the width is 10 cm, and the thickness is 6 cm. It is well preserved but broken at both ends. This is the most typical timber from the beam category. The width-to-thickness ratio is 1.66, which is close to the average ratio for this category. The dimension is similar to those *jangsaks* found on the Wando boat.[13]

BULKHEADS

Despite the importance of bulkheads in Chinese shipbuilding technology, and the expectation, therefore, that a large number would be present in the archaeological record, only fifteen timbers were assigned to the bulkhead category. This is 2.98 percent of the total number of timbers found. The average rank for the category is 2.4, and this is the best average next to the fasteners category. There is a large variation in size of the bulkhead timbers under analysis, ranging from 9.5 to 59 cm in height. The thickness exhibited a range from 4 to 16.5 cm. Eight timbers were assigned to ranks 1 and 2. These timbers can be further divided into two groups: small bulkheads with heights under 25 cm and larger bulkheads with heights of 45 cm or greater.

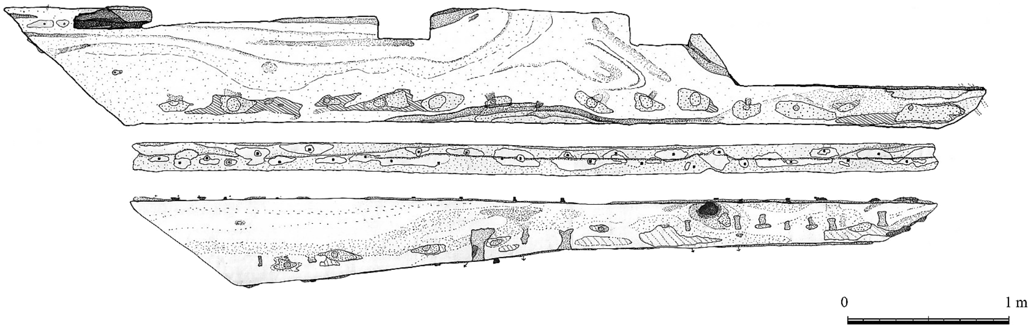

FIGURE 30. Drawing of a large bulkhead timber found at Takashima. Drawing by author.

This separation was apparent; there are no bulkheads with heights between 26 and 45 cm. The length also showed distinctions between the groups. All the timbers from the small group were less than 150 cm in length, while all timbers from the large group were 300 cm or longer. The two distinct sizes suggest the presence of two types of ships: a large cargo-type vessel and a smaller miscellaneous-purpose vessel or a landing vessel. In terms of comparative data, the archaeological evidence shows that the Shinan ship had a large bulkhead.[14] Bulkhead planks in other excavated smaller vessels are usually between 15 and 25 cm in height.[15] Based on this and the timbers at Takashima, it is certain that at least one large vessel, similar in size to the Shinan ship and most likely made in Fujian Province, was present and wrecked at Takashima. In addition, smaller vessels made in other regions of China were also present, but the available evidence cannot narrow down the origin of the smaller bulkheads to a specific area. More detailed discussion of these timbers follows.

Artifact Nos. 1439 and 1440: These two timbers are part of a bulkhead from a large vessel (fig. 30). They are two of the few hull elements still connected when found. This set is considered to be the uppermost portion of the bulkhead of a vessel, perhaps just below the deck level. The maximum length is 570 cm, and the bottom length, where it connects to the lower section, is 465 cm. The height is 60 cm, and the thickness is between 16 and 18 cm. The bottom of the lower section is 370 cm, and the maximum height is 59 cm. The thickness of the bulkheads from other archaeologically excavated Asian wrecks are about 12 cm or less, and the height of each plank does not exceed 25 cm, except that of the Shinan ship, which was 40 cm.[16] The shape and height of the bulkheads from Takashima do not exceed the expected value of the large ships built in Fujian Province, but they were built slightly thicker.

The top surface of the upper bulkhead plank has two rectangular notches located near the center that are about 30 cm in width and 18 cm in height. The two notches are set 115 cm apart. This is most likely where two longitudinal beams, or carlings, were placed, as seen in the Hangzhou Bay and Antung traders.[17] These vessels are traditional flat-bottom vessels of North China. The carlings provided additional longitudinal strength to these vessels without a keel. However, the shape of the bulkheads from Takashima suggests that the vessel had a sharp turn of the bilge and a possibly V-shaped hull with a keel, similar to the Quanzhou and Shinan shipwrecks. It is interesting to note that the bulkhead from a possible V-shaped vessel, Artifact No. 1440, had carlings. The carlings may have been installed for other purposes as well. Another interpretation is that there was an extensive mast support built onto the bulkhead. Chinese shipwrights relied on a tabernacle and bulkheads to disperse the stress of the mast throughout the hull, often constructing elaborate mast supports, as seen on some traditional vessels.[18] Perhaps the carlings were part of such a support system, which suggests that the vessel might have been large or that it was a vessel that required a large mast support.

The seam between the upper and lower sections of the existing bulkhead planks is made straight and has a notch, or a rabbet, carved to fit along the length. On the other hand, the seam of the lower bulkhead is made irregular, perhaps to prevent stress building in one area or because the shipwrights who built the vessel may not have had enough timber to make one big bulkhead plank. The seam between the two bulkhead planks is fastened with diagonally inserted nails set from both sides. The surface of the bulkhead into which the nails are set is carved, or recessed, and is similar to the bulkheads found on the Quanzhou ship.[19] The nails are set about 13 to 15 cm apart and carefully spaced. Almost all the nails are covered with concretion, but they present square sections of about 1 to 1.5 cm.[20] The Quanzhou ship has irregular nail spacing, often more than 20 cm apart, driven from both sides.[21] The Shinan ship also has nails placed diagonally as well as treenails on some of the seams.[22] With the Takashima timbers, the connection of the lower section to the missing bulkhead plank is similar. It has nails set diagonally from both sides, but the spacing of the nails is wider and more random when compared with the bulkhead connection above. There are broad and shallow dovetail-like carvings on the surface as well. This joint appears to have been weak and was most likely used as a temporary fastening while constructing the hull. This possible dovetail will be discussed in the joinery section in chapter 8. The uppermost surface of the bulkhead lacks substantial joinery, except for small nail holes where the deck planking may have been laid. This indicates that no additional bulkhead timber was placed above this one. There were several small nail cavities on the surface of the upper bulkhead timber, but the functions of these are not known. These nails are too small to have supported a substantial structure.

The fastenings of the bulkhead to the hull planking are also important to note here, as some of the other excavated Asian vessels provide excellent parallels for such joining methods. For this timber from Takashima, it appears that nails or bolts were driven from the outside. A concretion was present at one of the nail locations, but for all the others it appeared that the nails were pulled out before the concretion could form. Square holes can be seen clearly along the side, and they are spaced 10 to 15 cm apart. These holes measure approximately 10 cm in depth. The use of iron brackets as well as stiffeners, found on the other shipwrecks, leaves a trace on the surface of bulkhead planks. The surface of the bulkhead planks from Takashima, however, shows no such traces. The joining of bulkheads and planks thus appears to have relied solely on nails driven from outside the hull.

The timber can sometimes give information regarding the size of a vessel. A slight angle at the side of the bulkhead may indicate that this timber was located closer to the bow or stern. This bulkhead provides a wealth of information regarding what type of vessel it might have been. To determine the size of the vessel, the lines drawing of

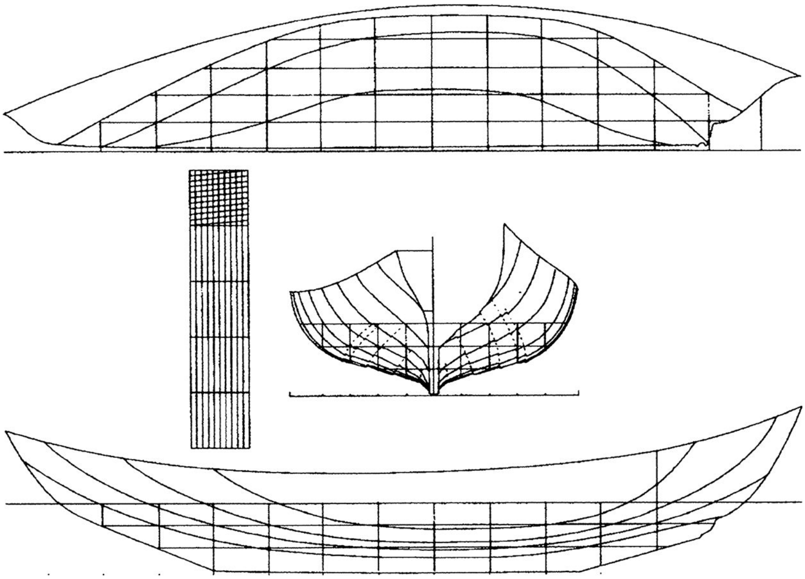

FIGURE 31. Reconstructed lines drawings of the Quanzhou ship (from Green, Burningham, and Museum of Overseas Communication History 1998, fig. 20). Reprinted with permission.

the Quanzhou ship (fig. 31) was used as a template to fit the curve of this bulkhead and the bevel at its side to find a possible position of the hull.[23] The scale of the lines was changed with a fixed proportion for that purpose. A line created using Artifact Nos. 1439 and 1440 was overlapped on this new lines drawing. The best fit of the two lines was found at the second station counting aft from the stern, with a slightly larger proportion than the original Quanzhou lines. This suggests that the Takashima vessel may have been larger than the Quanzhou ship, perhaps longer than 35 m. This interpretation is based on the assumption that the vessel was built using similar lines as the Quanzhou ship. As noted previously, many features from the Takashima timbers are shared with the Quanzhou and the Shinan ships, suggesting a similar ship type. Even if this was not the case, this bulkhead still suggests a fairly large cargo ship. As discussed previously, the Chinese ranked their ships according to the beam of the vessel. This is certainly a large ship with a beam wider than 7 m. Although it is not possible to confirm, this large vessel may have been the ship that once held the large anchor found at the site.

Artifact No. 949: This timber has a maximum dimension of 320 cm, a height of 45 cm, and a thickness of 16 cm. It has the general shape of a bulkhead from a V-shaped hull. The thickness of 16 cm suggests sturdy construction. Considering that the bulkhead of the Quanzhou ship was only 8 cm in thickness, this timber may come from a much larger transport vessel probably built in Fujian Province.[24] One enigmatic problem regarding this timber is that no component is attached above or below it. Furthermore, there are no nails set at the outer edges. One prominent trace of joinery is on its face. Several long lines of discoloration from rust and nail holes are present on two surfaces. These lines of rust are narrow, and the nail holes are regularly spaced. The first possibility that may explain this line is that it is the trace of a *gua-ju* nail or stiffener. The nails are driven in from both sides, however, and some pass through completely, making the use of such joinery unlikely. Another possible interpretation is that this timber was part of a bow or stern transom. Bow and stern transoms of both the Quanzhou and Shinan ships consist of multiple layers of planks; these planks are nailed directly to the inner transom planks. The transom is shaped like an upside-down triangle, and the width of the Shinan ship at the top of the transom is about 2.5 m.[25] If this timber from Takashima was indeed that of the transom, the original vessel may have been slightly larger than the Shinan ship.

THIN PLANKS

Fourteen timbers are assigned to the thin plank category. More than half of the timbers were assigned to ranks 1 and 2, and no rank 5 timber was found in this category. Timbers in this category were well preserved. The average width is 12.96 cm and the average thickness is 2.41 cm. The average length is 50.16 cm, but many of the timbers are broken. The average size of the nails from this category is about 0.6 cm square, while the majority of nail sizes from other categories were 0.8 to 1.2 cm. This is one of the distinctive characteristics of timbers in this category. Only in a few cases were small nails found on larger or thicker timbers.

Although the original function of these thin planks is not known, it is most likely that many of them are sheathing from Chinese ships. The Shinan ship had outer hull plank sheathing with a thickness comparable to that of timbers in this category.[26] Chinese shipwrights used these thin planks, directly nailed to the outer hull, as a protective and sacrificial plank against shipworms. The thin planks from Takashima, however, have only sporadically placed nails attached. Yet another interpretation for the timbers from this category is that these thin planks may have been used on deck superstructures or could be from containers.

Artifact No. 1859: This timber is well preserved. All but one original surface have survived. It is 24 cm wide, and the surviving length is 51 cm; it may have been longer and then broken with a clean snap. One small nail cavity is present, but it is placed at the plank's edge, and the original size of the nail cannot be determined. Another nail, placed at the center, goes through the entire thickness of the plank and is 1.2 cm square, which is the largest nail found in this category. This timber is assumed to be a side of a box or part of a small shipboard structure. The timber has too few nails to be considered a structural support.

Artifact No. 998: As one of the best examples in this category, this timber demonstrates almost all of the diagnostic features of a thin plank. The plank's overall length is 115 cm, its width is 20 cm, and its thickness is 2.5 cm. Two nails were found, 61 cm apart. These nails were 0.6 cm and 0.8 cm square. It is a relatively long piece, perhaps a part of a chest.

HULL PLANKS

A total of fifteen timbers were assigned to this category—a surprisingly low 2.99 percent of the total timbers. Many other timbers that were not included in this category, however, may be hull planks, but because of their degraded nature, they could not be definitely ascribed. To be considered a plank, a timber must have at least one nail set diagonally. Chinese shipwrights from north to south used nails placed diagonally to join planks together, and it is the most common feature found on all Chinese excavated vessels. Korean shipwrights did not use such a construction feature. The average rank for the category is 3.2, and no timber was assigned to rank 1. The majority of the timbers were assigned to ranks 2 and 4. The category as a whole shows one of the lowest ranks among the major components of the hull. The average length is 71 cm, and only two timbers were larger than 1 m in length. Considering that a plank is usually longer than at least 1 m in length, this once again affirms the highly degraded nature of the site. No planks found at Takashima were complete.

The average width of timbers in the plank category was 18.32 cm, but this measurement may not be useful in determining the origin of the vessels. The archaeological evidence seems to suggest that East Asian ships were built using various plank widths within the same hull. For example, the Penglai No. 1 and No. 2 had a plank width between 20 to 44 cm,[27] and the Ningbo ship had a plank width between 21 to 42 cm.[28] This makes the interpretation of the finds from Takashima difficult. The largest width from this category comes from Artifact No. 1456, which was 42 cm wide; this is close to the widest plank size for a Chinese vessel. The average thickness of timbers in the plank category was 7.04 cm. The excavated Takashima hull planks usually retain their original thickness. The thickness of 7 cm seems to be well within the range of variation for planks from other excavated vessels from East Asia. However, these other wrecks also evidence a wide range of thicknesses. The plank from the Ningbo ship had a thickness of 6 to 8 cm, the Shinan ship 8 cm, and the Penglai No. 1 ship 12 to 28 cm.[29] The size of a vessel is, however, difficult to determine from just the size of its planks. The Quanzhou ship had multiple layers of planks with a variety of thicknesses.[30] Considering the various plank thicknesses, the size and origin of the vessels from Takashima cannot be known from comparing this attribute.

Despite the wide varieties of plank shapes and sizes of Chinese vessels, one tendency of Chinese ships may be elaborated here. For some vessels and certainly for some of the Penglai ships and tradi-

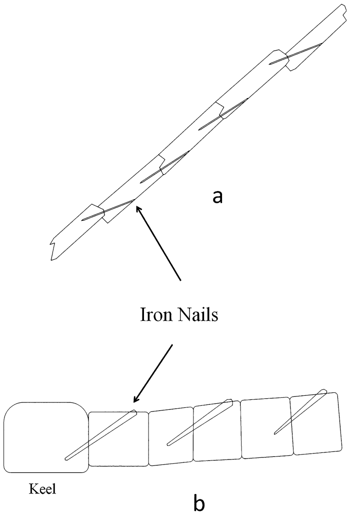

FIGURE 32. Nailing patterns found on (*a*) the Quanzhou ship and (*b*) Penglai No. 2. Drawings by author.

tional rivercraft, the planks closer to the bottom are thicker in cross-section shape.[31] The planks placed above the turn of the bilge become greater in width and appear more like a traditional western style of planking. The vessels with square planks are suitable for rivers and canals. It seems that Chinese oceangoing ships, such as vessels built in Fujian Province, were built with wider planks; no square planks were used. On the other hand, ships built in the north, such as the Penglai ships, exhibit planks that had almost rectangular cross sections in shape (fig. 32). All the planks from Takashima bear close resemblance to hull planks from ships built in Fujian and southern provinces. There appears to be no square planks from Takashima. This suggests that the planks found at Takashima may be from ships built in southern China. However, more research is needed to confirm this claim.

Artifact No. 202: This relatively well-preserved timber is 64 cm long, 12 cm wide, and 5.5 cm thick (fig. 33). It has several nails set at an angle and one round nail hole that goes completely through its thickness. The nails are in a peculiar configuration. They seem to be placed from below and above, as if this timber were laid down as a bottom plank with the nails placed in an X-shaped configuration. It is not common to see nails driven from both top and bottom, suggesting that this plank may have been constructed while being laid flat.

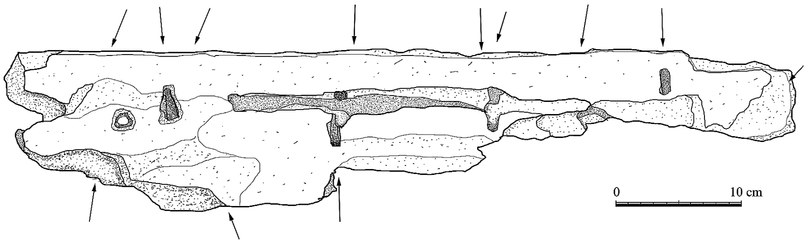

FIGURE 33. Artifact No. 202. Drawing by author.

If so, it seems to suggest that this timber was a bottom plank. It may have been a base timber for a piece of large equipment. With information available now, it is difficult to interpret the original function of this timber.

Artifact No. 1852: This timber is 92 cm long, 14 cm wide, and 4 cm thick. Compared with the other planks, this timber is thinner and narrower. It has nails placed diagonally set 25 to 30 cm apart. Extra nails are set through the thickness of the timber. These nails alternate along the top and bottom edge of the plank 15 cm apart in a zigzag pattern. When compared with planks described in ethnographic and archaeological records, the timber seems too small to have been a regular plank. This plank-like timber may be from a small boat, or it may be sheathing for the ship, as suggested by its peculiar nailing pattern. The middle layer of planking on the Quanzhou ship had a thickness of 5 cm, similar to this timber from Takashima.[32] The regular nailing pattern shows detailed craftsmanship, unlike the Quanzhou ship, where nails are irregularly spaced.

RAILINGS

A total of thirty-four timbers are included in this category, consisting 6.77 percent of the total timbers recorded, making this one of the most prominent categories. The average rank was 2.76. The average surviving length was 47.66 cm, the average width 6.75 cm, and the average thickness 4.60 cm. The most common dimension for this category was approximately 8 cm in width and 4 cm in thickness. My first impression of the timbers in this category was that they are too small to have been used on a large vessel, if indeed used as a part of a hull. Frames and braces are not commonly found on Chinese vessels. The Antung traders, a traditional watercraft in northern China, are said to have frames of approximately 10 by 16 cm.[33] The frames of the Ningbo ship are also much larger, 16 to 25 cm sided and 7 to 10 cm molded.[34] These frames were usually added on to the bulkheads and only acted as a minor support. Another feature that must be noted for this category is that none of the timbers were curved. This is not surprising because curved timbers were not widely used in the East Asian shipbuilding tradition. The use of the bulkhead to hold the hull in shape seems to be a logical and efficient method for avoiding the use of curved timbers. These railings were used for bracing planks together and did not provide major structural strength to the hull. Some may have served as vertical supports or beams, as was the case with the Yuanmengkou boat.[35] Vessels from Poyang Lake were also known to use vertical supports.[36] The sizes of the timbers from the railing category suggest that most were used on small vessels possibly built along the Yangtze River. Inland craft seem to utilize smaller wooden pieces to support the hull more than vessels built for overseas trade. The Quanzhou ship used fairing strips laid along the seam of the strakes.[37] Some of the small timbers from the railing category may have had a similar function.

One interesting aspect of this category is that it has the highest number of occurrences of nails set close to each other or nails in random order, perhaps suggesting repair. If these two-by-four-like timbers were used as bracing or framing for small vessels, it is not surprising to see many recycled and repaired elements. It is possible that some of the timbers from the railing category are from a small vessel; however, they are more likely from an upper structure, shipboard items, or part of an item, such as a shield depicted on the *Mōko Shūrai Ekotoba* scroll. The main body of the shield appears to have been built using woven bamboo, but the frames are made of wood. Many shipboard items, including catapults, may have been built using these two-by-four timbers.

Artifact No. 639: This timber has a square cross section of 6 cm and a surviving length of 82.5 cm. Three nails of the same size were placed approximately 25 cm apart at the same angle. Unfortunately, the origin of the vessel cannot be determined for certain. Most likely, however, this timber was part of equipment.

Artifact No. 1880: This timber is 78 cm long, 7.3 cm wide, and 4.3 cm thick. It seems to be a timber used to brace planks. Close examination revealed a dozen nails driven in the skinny plank. These nails were placed at various angles, and the sizes varied. Some are placed as close as 3 cm apart. It is, as a general rule, not necessary to place so many nails in such close proximity, which suggests repair or reuse of this timber.[38] The possibility of repair and reuse of the timber is discussed in chapter 9. Despite being an informative artifact in this respect, the timber offers no information regarding the origin, size, and type of vessel it is from.

FASHIONED TIMBERS

As noted previously, some of the timbers from the fashioned timbers category may have originated in Korea. The fashioned timber category includes a total of twenty-nine timbers—a number that is fairly high when compared with other hull components. It is 5.78 percent of the total number of timbers recorded. Although by definition these are nail-less timbers larger than 50 cm, the average length is only 65.05 cm. The average rank of 3.93 makes this category one of the most degraded categories. Many of the timbers were assigned to ranks 4 and 5 and therefore could more likely be remnants of timbers once full of nails. No timbers were assigned to rank 1, and only two pieces were assigned to rank 2. What can be determined comes from the average timber width, which is 19.19 cm, and the average thickness of 9.77 cm. This average width is similar to that of the plank category, but the average thickness is much larger, and these pieces sometimes have rectangular cross sections. The planks of the Wando boat are usually thicker than 10 cm, indicating some timbers found at Takashima may have derived from a similar vessel.[39]

Caveats aside, while the lack of iron joinery does not prove that

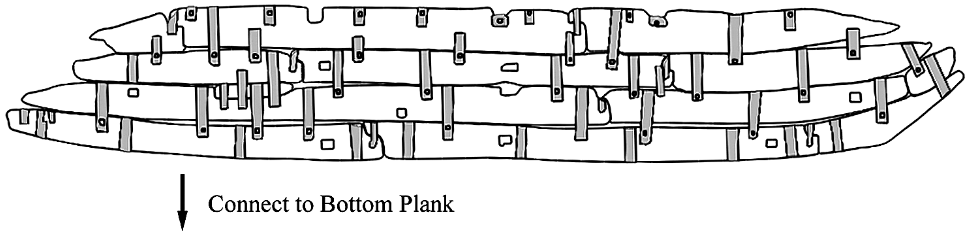

FIGURE 34. Plan view of the planks of the Talido ship showing *pisaks* (after Yuan 2006, plate 6). Reprinted with permission.

the timber fragments are from Korea, it is strongly suggested because there is no archaeological evidence to date of a Korean vessel built using iron nails. Korean shipwrights used wooden joinery extensively and exclusively. The contemporary Talido boat, found in Korea, shows a good example of this construction method.[40] Wooden joinery of *jangsak* and *pisak*, which went completely through the width of the plank (not the thickness), were features unique to Korean shipbuilding technology. Contrary to what might be expected, none of the timbers from this category had any trace of such joinery. Among excavated Korean vessels, the intervals of these wooden elements have varied significantly from ship to ship and even from plank to plank. The *jangsak* is used on the bottom planks and may be placed 110 cm apart, as seen on the Talido boat (fig. 34).[41] The Anjwa ship shows the interval of *pisaks* from 60 to 160 cm.[42] On the other hand, iron nails on Chinese ships are placed closer together, usually no more than 30 or 40 cm apart. Therefore, it is possible that some timbers from this category may be from a Korean vessel even though no characteristic joints were found. While only the possibility of the presence of Korean vessels can be suggested solely from these timbers, this finding may support the historical record's notation that mostly Chinese ships were lost in 1281 CE and that the Korean ships survived the storm to return home.[43]

Artifact No. 199: This timber is 63 cm long, with a square cross section of 10 cm. It may have been broken and originally had wider dimensions. The Wando boat had bottom planks that were 30 to 35 cm wide and 18 to 20 cm thick, while the side planks had a thickness of

10 cm.[44] The dimension of this timber is similar to the dimensions of the side planking of the Wando boat, but as mentioned above, no trace of wooden joints was found.

Artifact No. 304: The maximum length of the timber is 73 cm, and the cross section is approximately 13 by 31 cm. It is a large, highly degraded piece with a natural curve. The only feature is a rectangular cut or notch found in one area. This timber may be the frame of a vessel, or it could be a filler piece.

WALES

Despite the fact that the prominent features of Chinese junks of recent ages are multiple wales along the side of a hull, only five timbers collected from the site were identified as wales. Many fragmented wales may be placed with the railings or other timber categories, however. The lack of wales at the site requires explanation. The archaeological and historical evidence suggests that vessels built on the Yangtze River had definite wales, while vessels built in Fujian Province did not. The Penglai No. 1, for example, is equipped with wales that gave longitudinal strength while the Quanzhou ship had multiple layers of planks giving longitudinal strength to the hull.[45] The presence of only a small number of wales could suggest that some of the vessels whose remains have been found at Takashima were made in southern China and not along the Yangtze estuary or northern China.

Artifact No. 214: This possible wale is over 160 cm long, 14.5 cm wide, and 6 cm thick (fig. 35). The dimension of the wale of the Ningbo ship was 14 by 9 cm and is similar to this timber.[46] The timber from Takashima is flush on one side and has the natural curve of the wood on the other side. When carefully observed, the flat surface exhibits tool marks from an adze or plane, suggesting precision and care on the part of the shipwright who constructed this vessel. This timber has three nail patterns. The first pattern consists of nails set diagonally from this timber and driven into the timber below. The function of the diagonal nails is clear: they firmly attach the wale to the lower component. The second type has nails driven diagonally

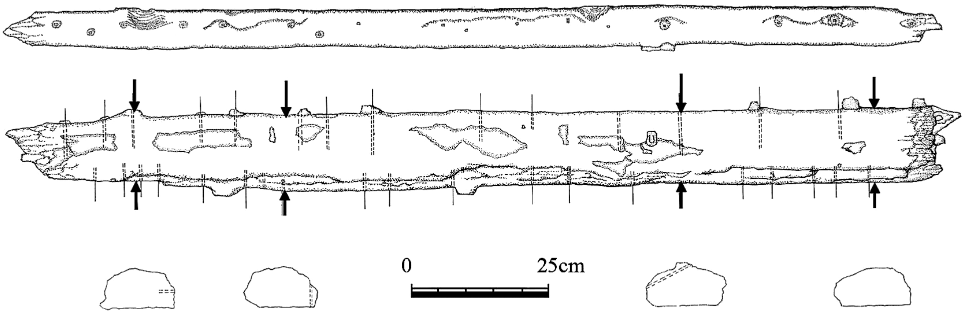

FIGURE 35. Artifact No. 214. Drawing by author.

from the timber above, spaced about 6 to 10 cm apart, and driven into the wale, just like the typical nailing pattern found in a plank. The presence of these diagonal nails suggests that the wales were incorporated into the structure of the hull and were not simply added on top of the hull planking. This feature can be seen on the reconstruction drawing of Penglai No. 1.[47] However, the timber from Takashima is much smaller than the wale of the Penglai ship—which was larger than 20 cm in both thickness and width. The third pattern has nails set straight and driven though the thickness, most likely set from the rounded surface. These nails are set 30 to 40 cm apart, and not all nails go through the wale completely. It is curious why some of the nails stop halfway. Perhaps another component was attached to the rounded surface. If this timber was a wale, it was from a small vessel based on its size.

Artifact No. 317: The surviving dimensions of this timber are 116 cm long, 25 wide, and 11 cm thick. The naturally curved wood surface has survived, and a leveled surface can be seen on the opposite side. Three nails were observed, but because of the deteriorated nature of the timber, it is likely that there were other nails whose presence and positions are now lost. One nail goes through the thickness near the center, most likely connecting the timber to the plank. This plank may have been laid on top of the assembled hull because there was no trace of diagonal nails. Thus, this vessel demonstrates a different way of attaching wales than that found on Artifact No. 214. The width suggests a fairly large ship when compared with the size of the Ningbo ship, which had wales about 14 cm wide.[48] If this timber was indeed part of a wale, it is from a large vessel built on the lower Yangtze River.

Artifact No. 354: The surviving length of this timber is 51 cm, the width is 8.5 cm, and the thickness is 4 cm. There are tool marks on both surfaces. This piece was not a simple split log, but was purposefully carved into shape. It has five nails, all likely driven from the rounded surface to the flat surface. All nails were 0.7 cm with square cross sections, and most likely driven in at the same time; these are small nails found on many of the thin planks, which are rare on other timber categories. The nails were placed at various angles, but all tips came out close to the center line of the flat surface, about 10 cm apart. This timber may have been used as a gunwale. The size of the timber suggests that it was for a small vessel and was nailed directly on top of an existing hull planking.

FASTENERS

Eight timbers were included in this category. These timbers are divided into two groups. One group represents timbers with a rounded shape like a peg, dowel, or treenail. The other group consists of timbers with a rectangular shape, like a tenon. These joining elements are an important source of information to help determine the origin of the vessel from which it derived. All fasteners found at Takashima are unique, and details of that analysis are presented in chapter 8.

MISCELLANEOUS COMPONENTS

The miscellaneous components category cannot be generalized because each timber is unique. A total of fifty-two timbers were recorded, representing more than 10 percent of the total timbers found. This category includes frames, knees, mast steps, and rudder posts. Some timbers were small, while others were large, depending on their function. Most had a specific function which is difficult to determine at this stage of research. Some of the timbers in this category are described in the next chapter.

LOGS AND CUT LOGS

The categories of logs and cut logs include timbers with round cross sections and no nails. Those with a modified surface, such as a cut, were assigned to the cut-log category; a timber without a cut was assigned to the log category. Each category has forty timbers. These eighty timbers add up to 15.94 percent of the total timbers from the site. In other words, one sixth of the timbers excavated from the site appeared to be simple driftwood. Some of the wood in this category (as well as timbers from other categories) may not be related to the invasion, and the interpretation must take this fact in account. In addition to descriptions of samples of this category, an overall description is provided below.

Except for a small number that are longer than 1 m in length, most of the timbers are less than 50 cm in length. Artifact Nos. 644, 1070, and 1805 are between 100 and 200 cm, and Artifact Nos. 1069 and 1812 exceed 200 cm. These timbers most likely served a similar function. Artifact No. 1070 has a peculiar feature: one end is pointed. This is probably a piling or stake. In the *Mōko Shūrai Ekotoba* scroll, a solider holds a long stick that probably served as a stand for a shield (fig. 36). The average length of the timbers, excluding the five long timbers, is 49.34 cm, and as all are similar in size and shape, they must have had a similar use. The most logical use for these logs was firewood (fig. 37). Ethnographic examples from Canton indicate that ships usually carried bundles of firewood 38 cm long.[49] In addition, many firewood-like logs were carried on board the Shinan ship.[50]

According to ethnographic and historical records, Hunan Province was a major supplier of wood, and Fujian Province was also mentioned as a center for the firewood trade.[51] Khubilai ordered both of these provinces to construct vessels; perhaps he was also thinking about the supply of firewood when making the decision. Considering the large number of timbers from this category, supplying these vessels with enough firewood may have been a major concern. While building vessels, many trees were cut down. Pieces not fit for building vessels were probably collected and used as firewood. Researchers have not focused on the use of firewood on board a ship, but when examining an invasion of this scale, even firewood may provide useful information if properly studied.

Firewood could have served several purposes on board, but cooking comes to mind first. The voyage to Japan would have been long and required large amounts of firewood for the entire trip. Another use for firewood was communication between ships. The distance and direction of the vessels during the day was easy to detect; at night, however, it was difficult to know the position of one ship relative to another. It was important to keep the fleet as organized as possible. To accomplish this task, fire was the obvious and most logical solution. A vessel could use fires on deck to guide the fleet at night. The use of fire to communicate on board was a well-known practice at

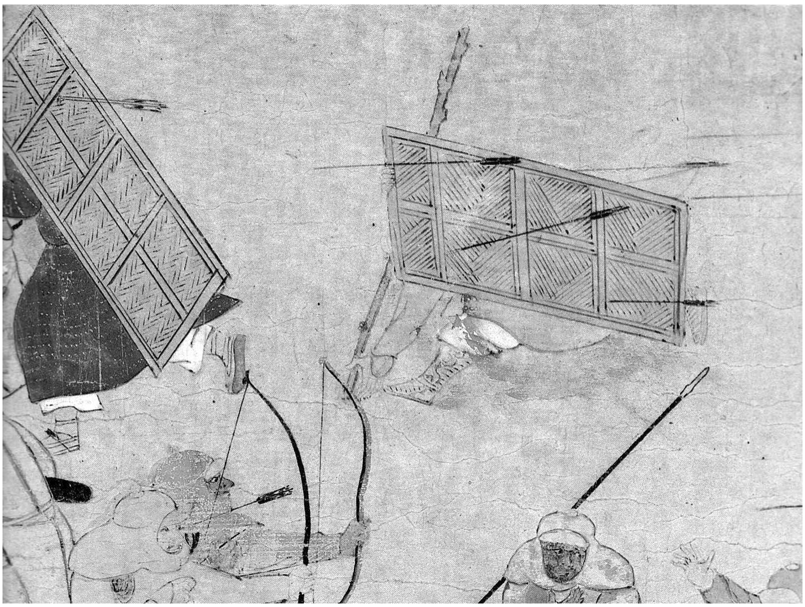

FIGURE 36. Possible use of long logs as seen on the *Mōko Shūrai Ekotoba* scroll. Courtesy of the Japanese Imperial House Museum.

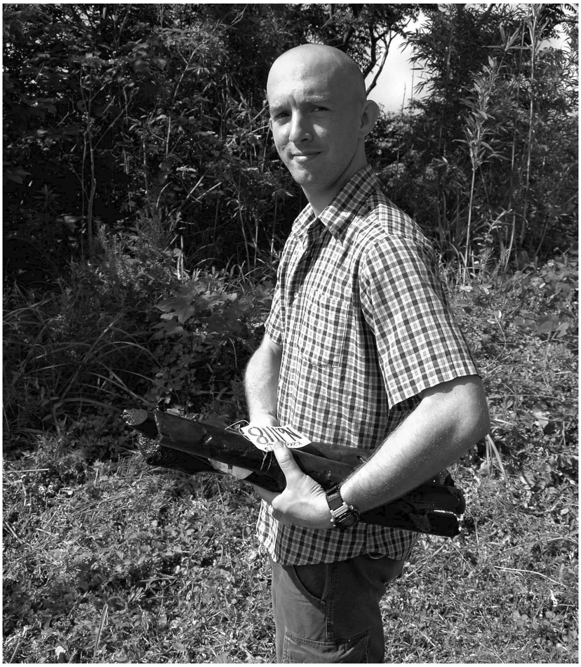

FIGURE 37. Firewood being carried. Photo by author.

the time and is noted in several historical documents; the Chinese, Koreans, and Japanese used this method.[52] For instance, a Chinese envoy sent to Korea in 1124 CE mentions the use of fire to communicate between ships.[53]

UNIDENTIFIABLE

The unidentifiable category includes timbers that have a trace of joinery or an original surface, but their function cannot be identified. Unfortunately, with 129 timbers, the unidentifiable category has the largest number of entries and represents 25.70 percent of the timbers excavated from the site. Only the dimensions of select timbers were recorded, as the information was not expected to reveal any significant insights. Most of the timbers fall between 10 and 25 cm in length. Several timbers, including Artifact Nos. 653 and 1021, had different sizes of nails driven in various directions, which suggests repairs. These may have been part of a railing, plank, or bulkhead. Several timbers may be identified as part of a larger timber. Many timbers may be filler pieces, like chocks used to fill gaps between structures. Many of these small fragments were obviously used to construct vessels.[54] Nevertheless, these timbers do not possess architectural context, and hence information they can provide about East Asian shipbuilding technology is minimal.

FEATURELESS TIMBERS

This category contains timbers that show no modification or observable features. All of these timbers are highly degraded and have no original surfaces remaining. They may have been part of a larger component where all modified surfaces and locations where nails were placed have been broken off. A total of 112 timbers were recorded, representing 22.31 percent of the total timbers recorded. Combined with the unidentifiable category, these two categories represent nearly 50 percent of the timbers discovered at the site. This large number indicates the extreme dynamics of the site formation processes at Takashima, where seasonal storms and proximity to shore have combined to reexpose and break up timbers not deeply buried. These timbers are also heavily damaged by shipworms. Unfortunately, nothing more can be said about these degraded timbers.

Chapter 6 Miscellaneous Timbers

Based on the historical and archaeological evidence, the timbers discovered at Takashima represent the remains of ships from Korea, along the Yangtze River, and Fujian Province in China. The timbers found at Takashima are from many parts of these vessels and their equipment. Because almost all of the timbers were single finds and not connected to other components, individual pieces of timber required in-depth analysis in order to reveal the smallest traces of evidence to shed light on where a particular timber may have come from. This process also requires a deep understanding of the complexity of East Asian shipbuilding technology. The timber category database, discussed in the chapter above, was a useful approach in analysis; however, many timbers were placed in the miscellaneous category. In this chapter some of these timbers from the miscellaneous category will be illustrated, with interpretation of their original function, the possible origin of the vessel, and what this discovery may tell us about the invasion. The list is not in any particular order because any order assigned to these timbers has to be based on arbitrary value or interpretation that may change after additional work at Takashima and subsequent reanalysis.

Artifact No. 193

This is an important timber because it helps determine the size of the vessel it came from. Based on a comparison with other excavated vessels and historical records, it is suggested that this piece is a mast step from a Chinese vessel. The "mast step" in Chinese shipbuilding may be called a tabernacle step because it is designed to hold

FIGURE 38. Artifact No. 193. Courtesy of Matsuura Board of Education, photo by author.

mast-partner tabernacles in place with the mast in between, braced by bulkheads and possibly other longitudinal beams or carlings. The timber is 130 cm long and 31 cm wide, and its maximum thickness is 16 cm (fig. 38). Overall, this timber appears to be made of a poor-quality wood and with poor craftsmanship. One of the rectangular slots where one (of two) heel of the tabernacle was placed is 10 by 13.5 cm, while the other is 9 by 12 cm. The distance between the openings is approximately 35 cm. This does not represent the maximum diameter of the mast, as the mast may have tapered at the heel, or the tabernacle may have been notched and inserted. Several traditional vessels are reported to have used such methods.[1] The heels of the tabernacles were inserted into the slots and secured by wooden pins; however, at Takashima neither the tabernacles nor the wooden pins have been found. One side of the tabernacle slots has a small square hole of 4.5 cm where the pin was inserted. Indentations of a smaller size were found inside the wall of the heel slots across from the square hole for the pin. This shows that the pin was inserted from the outside of the mast step, going through the heel and stopping inside the mast step. The locking element, or a pin, was square-shaped but was most likely tapered slightly toward the tip. Small nails were driven diagonally into the base of the tabernacles to secure the mast step to the hull. There are large holes at several locations along the side, but these might be from shipworm activity. The small nails would have been insufficient to secure the mast step. Instead, it is probable that a wooden pin firmly affixed the mast step to the bottom. A diagonal groove was cut into the base of the mast step, 8 to 9 cm wide and 5 cm high. This groove was filled with a chalky white putty-like substance, most likely *chunam*. Such joinery is not known from archaeological evidence; a discovery of a new shipwreck may bring additional information to light on this fastening method.

While this timber appears to be a crudely made timber and thus may imply that the vessel as a whole may have been built in a hasty manner; however, this is not the case. In Chinese ships a mast step played a relatively minor role in bolstering the strength of a mast, a different philosophy than that employed on western ships. In a Chinese system of mast support, there was no need to perfectly shape the mast step. This is an important point to be made; however, it is sufficient to state it briefly here as a reminder of the danger in interpreting hull components that were built with a different philosophy of shipbuilding. This topic will be discussed briefly again in chapter 9.

The shape and size of the mast step is an important clue for determining the shape of the hull. The mast steps of the Quanzhou ship were laid directly at the bottom of the hull, and the bottoms of the mast steps were made to fit the shape of the hull. The mast step of Penglai No. 2 was flat, however; it had a notch to fit the protruding keel inside the hull.[2] If the mast step from Takashima was placed directly at the bottom of a hull, the bottom of the hull must have been level for more than 130 cm across without a keelson or an internal keel projection. The diagonal notch at the bottom also suggests another interpretation. The mast step may have been a composite structure, and this timber was the upper section of a larger component. The Shinan ship had an elaborate structure for its mast step; the mast step was composed of several components that braced the tabernacles.[3] The Shinan shipwreck's mast step strengthened the tabernacle by having a wooden pieces that fit both on the top and the bottom (fig. 39). In other words, the mast step was built around the tabernacle.

FIGURE 39. Mast support structure of the Shinan ship. Courtesy of the National Maritime Museum of Korea, photo by author.

This may be an elaborate mast-step structure, or perhaps this timber was placed on a deck, although no other examples have been found at other archaeological sites. The flat base of the mast step is not enough evidence to confirm that the vessel had a flat bottom.

Perhaps an estimate for the size of a vessel is possible based on the dimension of the mast step. The maximum dimension of the main mast step of the Quanzhou ship is about 260 cm, or twice as large as the timber from Takashima. The maximum dimension of the foremast step of the Quanzhou ship is about 200 cm. Both main and secondary mast steps are larger than that from Takashima.[4] The Penglai No. 2 also has a mast step close to 200 cm.[5] All these are, however, fitted to the bottom, and the mast step follows the shape of the hull, and there is little archaeological record of a mast step from a completely flat-bottom ship, as the vessel associated with the Takashima site may be. Although the distance between the tabernacles does not directly represent the diameter of the mast, the distance can still be utilized to give a basic idea of the size of the vessel. The estimated diameter of the foremast of the Quanzhou ship is 37 cm and is closest to the size of the mast step recovered from Takashima, which is about 35 cm.[6] The distance between the tabernacles of the Ningbo ship is much smaller.[7] For instance, the Penglai No. 2 has tabernacle openings of 16 by 22.5 cm, which are almost twice as large as those from Takashima. It appears that the mast step from Takashima may be from a large vessel, but the mast step alone cannot be used to make any conclusive statement.

Artifact No. 307

This timber is carefully made and well preserved, with a length of 176 cm, a width of 18 cm, and a thickness of 8 cm. The body is notched and becomes narrower at one end. The top of the wider end is rounded, and a circular opening is present (fig. 40). This is a windlass stand of a Chinese vessel. It is made of camphor wood, which is native to southern China. A rectangular hole is located on the timber directly below where the width changes. This corresponds to where it was notched into the deck, and a locking pin is located below deck to secure the windlass. Although the pin did not survive, the dimensions are estimated to have been 3.5 by 6.5 cm. This was the only joinery found on this timber. There were two basic types of windlasses in medieval East Asia: one that was attached to the mast as part of a tabernacle and one that was standing independent near the bow and was used to raise the anchors. The windlass attached to the mast was used to operate the running rigging and halyards. Such a configuration can be seen in many examples of iconography depicting traditional vessels. The reconstructed figure of the windlass presented by Yamagata is almost exactly the same as the timber recovered from Takashima (fig. 41).[8]

The diameter of the circular opening where the shaft was placed measures 12 cm. This information was helpful in reconstructing the windlass. The windlass is a common element on many sailing vessels; however, it was not helpful for determining the vessel's origin. No written records correlating the size of the shaft of a windlass and the size of a vessel exist. However, experimental archaeology may be used

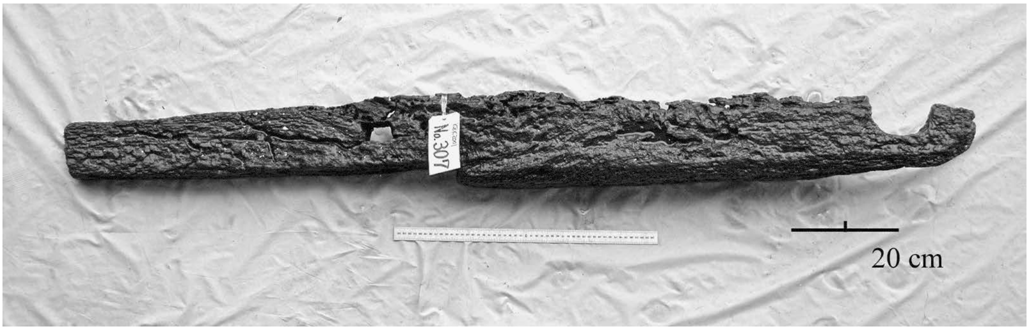

FIGURE 40. Artifact No. 307. Courtesy of Matsuura Board of Education, photo by author.

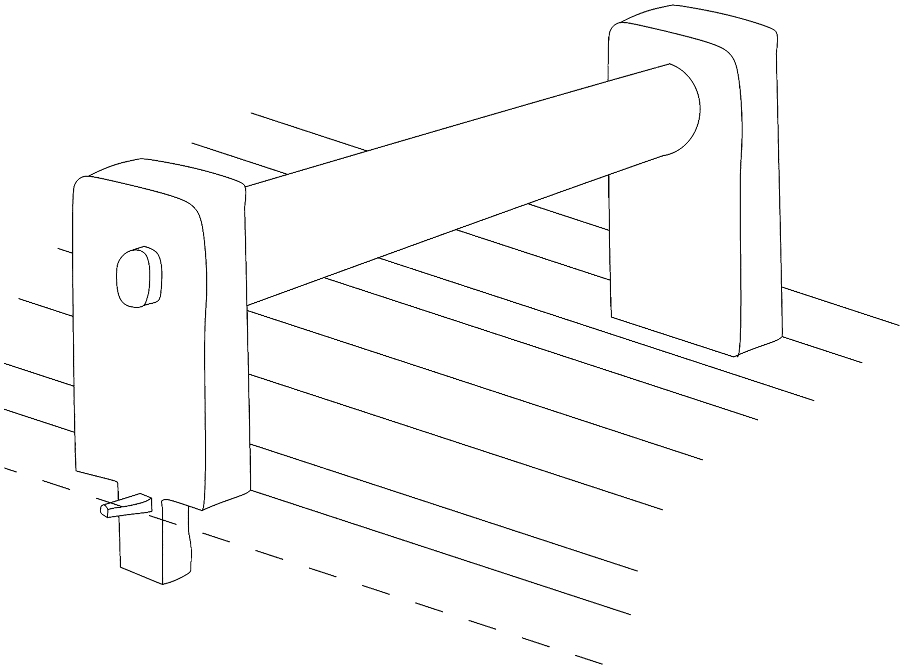

FIGURE 41. Drawing of a windlass from a traditional vessel. Drawing by author.

to calculate the maximum weight that such a structure can raise and thus determine the upper limit of the size of an anchor that the vessel might have carried. A picture of a windlass can be seen on the *Mōko Shūrai Ekotoba* scroll. The windlass in the drawing has an elaborate shape while the windlass from Takashima appears simple in form.

Artifact No. 601

This 300 cm long timber is 48 cm wide and 16 cm thick; it is wider and thicker than any ship planks discovered in China. The timber has a large rectangular opening at one side, located close to the edge. The rectangular opening is more than 20 cm long and 20 cm wide, with several small nails placed around it. Because the nails are covered with concretion, the size, direction, and shape of the nails could not be observed. These nails were too small to provide any structural strength, and no other trace of joinery was detected on the timber. It may be part of a hull, but a logical explanation for not having any joinery must be given. If this was a component of a vessel, it must be from an extremely large ship. It may also be a component of a piece of large equipment, perhaps a catapult. There is no comparable find that can identify this timber.

Artifact No. 1476

This artifact was probably used as a frame or a support for a large vessel. It is 260 cm long and shows a changing angle of curvature (fig. 42). Several nails pass through the thickness of the timber, suggesting that it was connected to another supporting component, most likely to a bulkhead. The curve is not symmetrical, and it was most likely placed on one side of the hull like a futtock or a knee. One area shows an abrupt change or a step at the curve, which implies lapstrake construction, but the rest of the line is smooth. If this was the case, the shape of the hull would have had a steep angle of deadrise. The timber

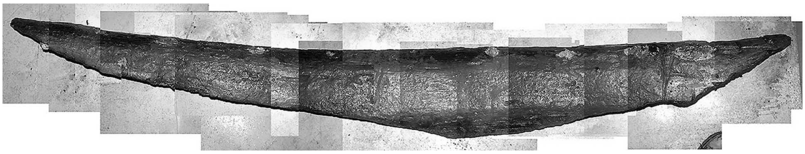

FIGURE 42. Artifact No. 1476. Courtesy of Matsuura Board of Education, photo by author.

could have been situated either close to the stern or the bow. Comparative analysis between the curve of the timber and the available lines from excavated vessels was not conducted because the location and the angle of the timber could not be determined.

Artifact No. 1861

During the initial analysis, this charred timber was considered to be a part of a rudder stock, but it may have served some as yet unknown function. The surviving length is 225 cm, and it has a 16 cm square cross section at the top that gradually tapers and breaks where it was thought that rudder blades might have been attached (fig. 43). One hole located near the top is 8 by 10 cm, which tapers to a smaller 4 by 8 cm at the other side. Another hole is 8 by 10 cm and tapers to 7.5 cm square toward the other side. Both holes are at the same angle and taper toward the same side. The rectangular openings were originally believed to be where the tiller was inserted. According to historical and ethnographical accounts, one of the characteristics of a Chinese junk's rudder is that it can be lowered or raised to shift the center of gravity. The two holes are thus needed to adjust the ease of use. The size and shape of the rudder and the rudder post vary according to where the vessel was built, its function, and size.[9]

Information from the excavation at the Ming dynasty Treasure Fleet shipyard yielded two complete rudders and one badly damaged rudder (fig. 44). These rudders were more than 10 m in length and approximately 40 cm square in cross sections. The openings for the tillers are about 12 by 18 cm, and the distance in between the two openings is 34 cm.[10] This "rudder post" from Takashima is extremely small, but the size of the openings are not much smaller than the examples from the Nanjing shipyard. Furthermore, the distance between the openings poses a problem. It is too wide to consider these as tiller sockets. Ethnographic records, collected by Worcester, were also consulted, and the proportion between the size of the timber and the distance between the mortises does not match that of any of the rudders.[11] Another interpretation is that the timber is part of a small anchor. The two holes are where the frames for holding two anchor stocks were placed. Unfortunately, there is not enough evidence to affirm this claim. The function of this timber is still unclear, but perhaps one day it may be revealed by a similar find elsewhere.

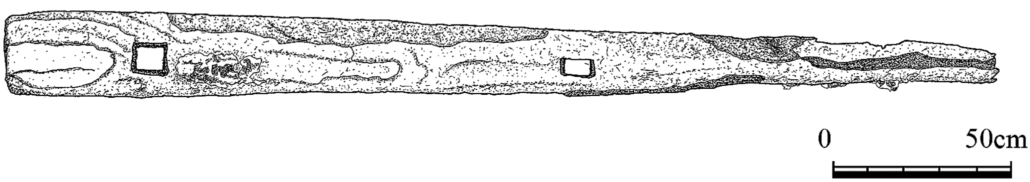

FIGURE 43. Artifact No. 1861. Drawing by author.

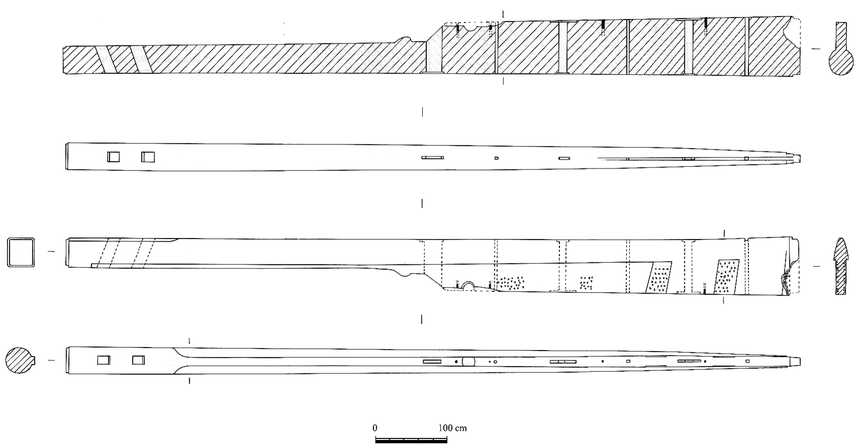

FIGURE 44. Rudder No. 2, discovered at the Nanjing shipyard (redrawn by author, with modification, from Nanjing Municipal Museum 2006, fig. 61).

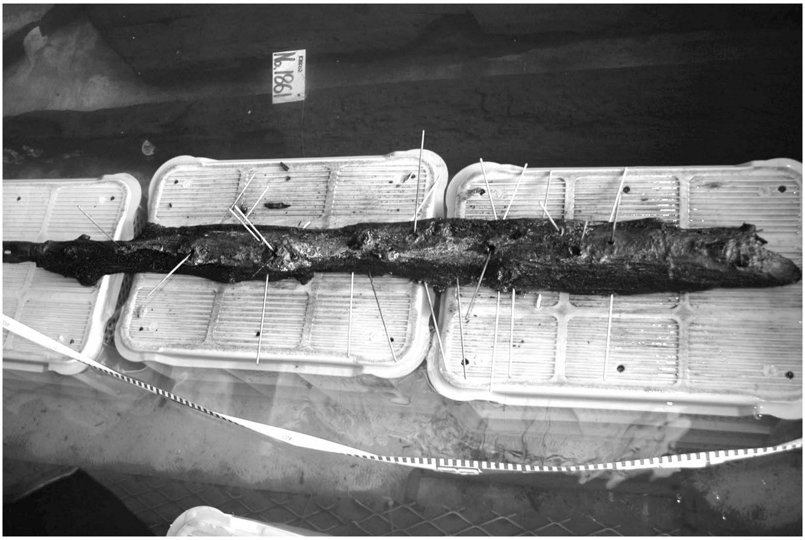

FIGURE 45. Artifact No. 1447. Courtesy of Matsuura Board of Education, photo by author.

Artifact No. 1447

The timber is degraded, but it retains a square cross section of 8 cm with rounded edges and a length of 125 cm. The surface is "plagued" with numerous nail holes (fig. 45). More than thirty nails of various sizes were driven into the wooden piece from every angle. There is no order in the placement of nails, with some going through while others stop halfway in. This timber may have been utilized as a spiked club with protruding nails, but this is unlikely. Another interpretation is that the timber was part of a defensive strategy to prevent an enemy from boarding. The nail-spiked timber may have been placed as a gunwale along the side of a hull. When enemies tried to board the vessel, their hands caught on the nails. Chinese treatises state that such defensive mechanisms were used.[12] The *Mōko Shūrai Ekotoba* scroll depicts Japanese defenders, in small vessels, attacking the invading Mongol fleet, suggesting that a defensive tactic such as a nail-studded rail would have been successful.

Artifact No. 2004–26

The presence of a limber hole, the symmetrical shape, and the size strongly suggest that this is a floor timber, i.e., a frame laid at the bottom of a hull. This 170 cm wide frame was placed at the bottom of a hull with little deadrise (fig. 46). This clear indication of the type of timber also provides a reliable means of determining the origin and type of vessel. All nails were driven from below the hull and were not attached to any other components, including a bulkhead to a side or a top. This was an independent component that held planks in place. The shape of the floor timber suggests a narrow vessel with a rounded or almost flat bottom.

A close analysis of this timber reveals that some sort of internal keel was used. Although one side is broken, it can be assumed that an indentation was present at the center for the bottom timber to be fitted to a keel. The width of the absent keel is estimated to be approximately 30 cm. Nails were driven straight from the bottom, indicating that they must have gone through the planks and into the frame. If a developed keel was in place, rather than a keel-plank, the length of the nail would have exceeded 40 cm. This is highly unlikely. The nails could be safely driven from below without losing holding strength. All evidence seems to suggest that this is a fragment of a purposely made landing craft. To carry a large number of troops for a short distance in a small vessel, flat-bottom vessels with light framing were needed.

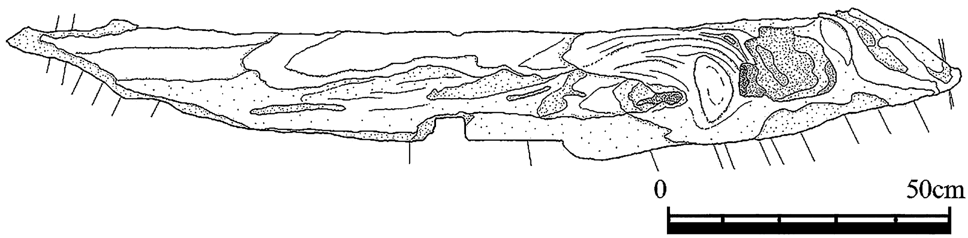

FIGURE 46. Artifact No. 2004–26. Drawing by author.

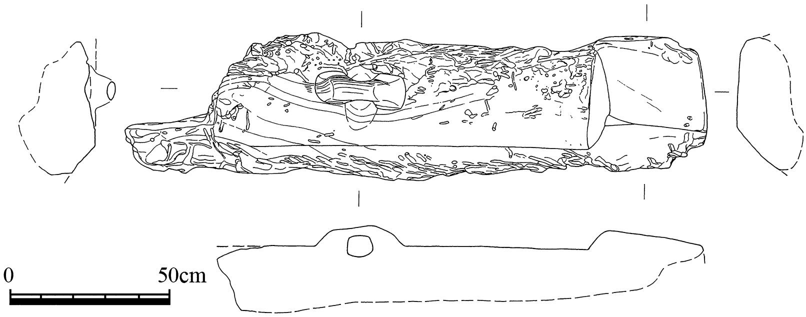

FIGURE 47. Artifact No. 2000–18 (from Takashima Board of Education 2001, fig. 20). Reprinted with permission.

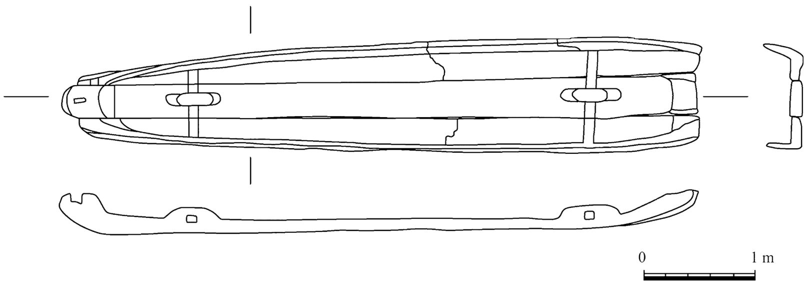

FIGURE 48. Plan of the Anapuchi boat (redrawn by author, with modification, after Kim 1994, fig. 22).

Artifact No. 2000–18

One timber that must not be omitted when discussing the hull fragments found at Takashima is Artifact No. 2000–18. I have analyzed timbers found only after the 2002 season, and thus this artifact is not included in the database discussed above. This is again an isolated find, and it is one of the few hull fragments found before 2002. The plank has a large carved cleat where another transverse element was placed to hold the planks to the side. It is 195 cm long and 62 cm wide (fig. 47).[13] The carbon-14 dating of the Kōzaki plank indicates that the wood is roughly contiguous with the time of the invasion.[14]

A similar timber was found on a vessel excavated from Anapuchi Pond in Korea (fig. 48).[15] The Anapuchi vessel had L-shaped chine strakes attached on both sides and exhibits a vestigial log-boat-like style. This inland vessel has been dated between the seventh and ninth centuries.[16] It is believed to be the type of vessel from which later Korean oceangoing ships derived. No *jangsak* or other joinery was found, and the transverse beam timber put through the cleats alone tied together the components. Although the similarity between the Anapuchi boat and the timber from Takashima is striking, the several-hundred-year difference in the two vessels must be explained. Another matter that complicates the interpretation of this timber is that the wood may not be from Korea but from China.[17] Perhaps it is a lost shipbuilding tradition that was widespread in East Asia.

Chapter 7 Species Analysis

WOODEN ARTIFACTS FOUND at Takashima have been identified by both genus and species.[1] Some of the wood, because of its waterlogged and degraded nature, has been identified only to the family level. The use of different wood species is one useful method in understanding where the vessels were built. This is because traditional shipwrights usually had a preference in choosing the types of wood they used to build vessels.[2] The total number of timbers analyzed was 475 samples. First, the results of the analysis organized by wood species and the overall results will be discussed. Following this, species distribution for each timber category is described.

Overall Analysis

In general, Chinese shipwrights used camphor (*Cinnamomum camphora*) or China fir (*Cunninhamia lanceolata*) to construct a hull. The lower hull, including planks and bulkheads, were made of camphor while the rest was built with China fir.[3] Pine (*Pinus* sp.) was sometimes used, but usually for the upper hull or sheathing. Worcester notes that camphor wood was an especially important wood for shipbuilders from Fujian.[4] The wood species of various archaeologically excavated Chinese ships has been identified. Almost all ships were built using camphor wood for at least some parts of their hulls. The Quanzhou ship was primarily built of camphor while the Shinan ship was built of pine; the Penglai ships utilized many species of wood. In summary, it appears that ships from southern China relied more on camphor, and middle China slightly more on China fir. The ships built in the north tend to use various species of wood. This should not be confused with the Korean vessels. The Korean shipwrights almost exclusively used pine for hull while *jangsak*, *pisaks*, and beams were made of oak (*Quercus* spp.). The Chinese and Korean ships are built according to a completely different tradition in construction philosophy as well as the types of wood they use.

The most prevalent timber types from Takashima are as follows:

1. pine—162 timbers (32 percent)
2. camphor wood—97 timbers (19 percent)
3. China fir—51 timbers (10 percent)
4. elm (*Ulmus* spp.)—56 timbers (11 percent)

Other wood species, including *Castanopsis* spp. and *Cryptomeria* spp. as well as the families *Cupressaceae* (cypress family) and *Taxodiaceae* (a type of conifer), were also present at the site but are substantially less numerous. Only 11 timbers (2.3 percent) were identified as oak. These are all woods widely available in southern China and were used by Chinese shipwrights for hull timbers. There are also exotic woods, such as *Cotlelobium* spp., which grows only in tropical Asia. Camphor wood does not grow in Korea, and thus these timbers most certainly came from China. Teak, or *Tectona grandis*, is native to Southeast Asia and was probably brought from there to China as a trade item. The Nanhai trade from Southeast Asia to China included teak as a commodity. *Terminalia catappa* is another exotic wood, mainly grown in Polynesia and used for building canoes because of its high water resistance. The presence of rosewood (*Dalbelgia* spp.) also suggests a vessel from Fujian Province, as the Shinan ship carried such wood as one of its principal cargo items.[5] Many of these exotic woods may not have been from cargo but from furniture.

One problem in analyzing the timbers from Takashima is the presence of many timbers not related to hull components. To correct for this, beam, bulkhead, and fashion timbers, miscellaneous timbers, planks, thin planks, railings, and wales were isolated from the rest of the timbers. The total number of these hull components is 174. Among them, 57 samples (32.8 percent) are camphor wood. Pine remains numerous at 39 samples, or 22.4 percent; this is a significant drop in percentage when compared with all timbers included. This is because most of the pine wood is identified as logs and cut logs. It can be suggested that the main hull components were not made of pine because shipwrights preferred camphor wood. China fir, another important wood for Chinese shipwrights, accounted for 26 timbers (14.9 percent), a slight increase in percentage from the unfiltered total. Two timbers are rosewood, but these were included in the fashioned timber and may or may not have been part of a hull.

Wood Species Distribution by Component Category

The data from wood species analysis as a whole does reveal some of the characteristics of ships present at Takashima, but this research reveals more information when the timbers are divided into smaller groups. The results of analysis for each hull component will be discussed below.

Beams: Timbers from the beam category demonstrate the use of a wide range of species. These include camphor, China fir, pine, oak, elm, and conifers. Beams are not a common feature found on Chinese junks, and perhaps these timbers are the beams and *jangsaks* of Korean vessels. However, the beams from Korean ships were usually made of oak and other hardwoods. *Jangsaks* were also exclusively made of hardwood. The presence of softwood suggests these "beams" are not from Korean ships but rather are rare examples of beam-like structures from Chinese ships. One reason for this is the use of camphor wood in some of the beams, which does not grow on the Korean Peninsula.

Bulkheads: All but three timbers from this category are camphor wood. These three are lower-ranking timbers assigned to the bulkhead category, and those three timbers also had a lower confidence level and hence were ascribed as "possible" bulkheads when analyzed. Camphor wood is extremely durable, water resistant, and unpalatable to shipworms. The wood grows mainly in southern China, and it was the choice of wood for building a hull by Fujian shipbuilders.[6] Archaeological evidence from other vessels confirms that camphor wood was widely used for bulkheads. The wood species analysis for the bulkhead category therefore confirms that these timbers have a high probability of being bulkheads made in China, perhaps near Quanzhou or in Fujian Province.

Thin Planks: The wood species analysis of the thin plank category shows an interesting result. Half of the timbers, or seven out of fourteen samples, are pine. Three are China fir, two are from a conifer tree, one is elm, and one is camphor. The Shinan ship's builders used pine for sheathing, and thus perhaps some of the timbers from Takashima may be sheathing. As a caveat, these thin planks may also come from a chest, or perhaps deck planking, as well as an upper structure. It can also be said that high-quality wood, such as camphor, was reserved for thicker components that supported the hull while pine was used for thin, light timbers.

Hull Planks: Nine samples were identified as camphor wood, which implies that the planks are from southern China. Cypress wood and pine had two timbers each. China fir, which was the wood used for the majority of timber excavated at the Nanjing shipyard, was only represented with one timber from Takashima hull planks. This evidence suggests that the planks are mainly from southern China or perhaps Fujian Province. Compared with the bulkhead category, the plank category shows more variation in wood species. This variation would confirm that Chinese shipwrights emphasized the use of camphor for the bulkheads while they used various woods for planks. This may also imply that the bulkheads played an important role as a central piece in shipbuilding. Pine and China fir were affordable and were used on planks—a hull component that would be damaged by shipworm. Camphor wood is relatively expensive and hence was used on those important components that do not get eaten by shipworms. However, it is a possibility that a sampling error may also play a role.

Railings: Fourteen timbers, or 42 percent of this category, were China fir. There were four pine timbers and only three camphor samples, but these were degraded timbers and were most likely from a broken component. The higher-ranked railings were clearly dominated by China fir. Chinese shipwrights may have explicitly used China fir to build these small frames and upper structures. A likely interpretation is that the shipwrights who used these railings timbers were from a small geographical area, and perhaps what we see at Takashima is from a single small boat or one or two pieces of equipment. China fir was traditionally used for shipbuilding, and was an important timber.[7] Most likely these timbers came from the Yangtze estuary, considering that China fir was extensively used at the shipyard at Nanjing. Unfortunately, no large number of similar "railing-like" timbers was recovered from the shipyard excavation.[8]

Fashioned Timber: Close to half of the wood in this category is camphor wood. Korean shipwrights did not use camphor wood for shipbuilding. Korean ships were usually built of pine, and six timbers from this category were identified as pine. None of these timbers were particularly well preserved. Two timbers were identified as possible rosewood, and one timber was teak. Rosewood was a main cargo of the Shinan ship, and this wood was not used in a hull component. The presence of teak also suggests the presence of expensive wood. The species identification did not prove useful for this category, or it may be that the fashioned timber category may not have been an excellent way of categorizing the timbers. Many of the timbers in this category may actually belong to the bulkhead or plank categories, and not from Korea, based on the species identification.

Wales: Two of the wales are camphor wood, two are elm, and one is China fir. The number of samples from the wale category is too small to conduct any meaningful analysis. Nonetheless, all of these timbers were most likely from southern China.

Fasteners: It is interesting to note that four timbers (Nos. 645, 828, 1297, and 1811-c) from the fastener category were identified as softwood. Softwoods are usually not used for such joinery, and perhaps these artifacts had different functions. The rest of the timbers are China fir, camphor, and conifer. These species are commonly used by Chinese shipwrights, but are not commonly found in Korea. The number of samples for this category is too small to represent the nature of fasteners found at the site.

Miscellaneous Components: The miscellaneous components represent an interesting category for the study of species identification. This category has the widest variation of species. Considering that the category includes various parts of vessels that functioned in many different ways, this is expected. Camphor wood was the largest group, with fifteen timbers, and the next largest group was pine with twelve samples, again suggesting southern China as the point of origin here, as is the case with most of the other categories. These trees are native to southern China and were favored by Chinese shipwrights, who used them extensively. *Castanopsis* spp., China fir, and elm are each represented by five timbers. There is no oak from this category. There is also no exotic wood, such as teak and rosewood, suggesting that timbers from this category were mainly utilitarian in function. Because the category is "miscellaneous," without any clear distinctions, each timber must be studied as a separate entity.

Logs and Cut Logs: The results of the wood species analysis for logs and cut logs matched expectations. Most of the wood in this category was softwood, and 63 percent of the timbers are pine. The result may surprise some because softwood, such as pine, is not usually known as a good choice of wood to be used as firewood. Hardwood is usually considered an excellent choice for heating a house because it burns for a long while and produces more heat. Nonetheless, if we consider that the last thing sailors want on board ship is fire, having softwood as a fuel makes perfect sense. Softwood, such as pine, burns out quickly, thus reducing the danger of fire spreading to the rest of the ship. Another characteristic of pine is that it produces a large amount of smoke. As described above, this is advantageous because the Chinese used smoke to communicate between ships. One must note that elm was the most common hardwood within this category (16 percent). Elm is not a particularly popular tree for heating because it produces a large amount of smoke. One last advantage of the softwood is that the wood does not require a long period of time for seasoning, as compared with hardwood, and it can also be used when slightly damp. Thus, it is reasonable to assume that pine was preferred over other woods on a ship.

Unidentifiable: The unidentifiable category is difficult to interpret. Twenty-seven percent of the timbers are pine, 25 percent are camphor wood, and 15 percent are China fir. Both elm and conifer trees are represented by seven timbers each, or about 5 percent each. Two rosewood samples and some rare wood species were also found. No oak is found in this category.

Featureless: The timbers from the featureless category are from a wide range of wood species. This is as expected. This category includes camphor wood, pine, oak, and rosewood. Thirty-two percent of the timbers are pine, 21 percent are elm, and 7 percent are camphor. Pine and elm were used mainly for firewood and are not found in great quantities in other categories. This would imply that some of the small featureless timbers are simply degraded firewood. The camphor, China fir, and oak fragments are most likely from a vessel or from other shipboard items.

The Results

The wood species analysis was one method that provided clear insight into how the invading fleet was organized and where the vessels were constructed. First, many of the large timbers derived from ships built in southern China. This is because camphor wood does not grow in Korea. Second, not many timbers can be assigned as coming from Korea. Many samples from the fashioned timber category were not from Korea. This result corresponds well with the artifacts analysis, which attributed only a handful of ceramic remains to Korea. The third point to be made is that overall, the timber category database and wood species analysis correspond well. As mentioned above, almost all bulkhead timbers were made of camphor wood, and also firewood specimens were mainly of pine.

Another point to be made is that the variation of species was relatively limited. The number of wood species found at the site appears to be rather low considering the possible number of ships that were wrecked during the storm. The results seem to indicate that the wood used to build the hulls of ships brought to Japan were not made from various types of species but was rather limited to camphor, China fir, and some pine. The smaller components and objects were perhaps made from varieties of species. The wood species that shipwrights used appear to follow a common practice known from the past. This implies that the vessels were not made of low-quality wood, but it can be suggested that shipwrights maintained a high standard while building the vessels. One may assume that at the time of war, resources may be scarce and shipwrights were forced to use lower quality of wood. However, this was not the case, as environmental stress on timber resources cannot be seen from the results. The small variation in wood species may also imply that we are looking at only a small number of ships. Perhaps most of the timbers found at Takashima derive from two or three vessels made in southern China.

Chapter 8 Joinery Analysis

IN PREVIOUS CHAPTERS the timber category database and the wood species analysis were discussed. Another methods used to analyze the timbers from Takashima was to study the joinery found on the timbers. Joinery is defined as the way in which a timber is connected to another timber. Various types of joinery are represented on the Takashima timbers. The two basic divisions of the joinery are those with nails and those without nails. The joinery without nails—or wooden joinery—includes notches, scarfs, mortises and tenons, and rabbets, which were grouped and analyzed together. Timbers joined with iron nails will be discussed first, followed by joinery without nails. The last section will illustrate some of the unique joinery from the site, including *chunam*, the white putty mixed with fiber and used by southern Chinese shipbuilders to coat the hull.

Joinery with Nails

Among the 502 timbers analyzed, 190 samples (37.84 percent) had at least one nail driven into them. While this does not seem to be a large number, many of the wooden artifacts from the site, including firewood, are not from a hull. For this reason, the timbers from beams, bulkheads, thin planks, planks, railings, wales, fashioned timbers, and miscellaneous components were isolated; this represented 177 specimens. Among these, 122 timbers had nails. In other words, 69 percent of the timbers from possible hull remains had nails. Most of the remaining 55 wooden fragments represent the fashioned timber and miscellaneous components categories. The large number of timbers with nails suggests that nails were the primary fastening method used for the vessels represented at the site. Almost all of the nails found were placed diagonally, through the width or thickness of the timber. There is no evidence for the use of an iron strap or other metal fasteners. There is no evidence of copper, bronze, lead, or other such metal used for fastenings, but new evidence may become available once the conservation process is completed.

Because there are only a few hull components that were found connected to each other, it is not possible to determine how the nails were used on certain components, except in the case of certain well-defined artifacts, such as the bulkheads. Determining the actual size of the nails may be difficult, as iron does not survive well underwater and the surfaces are covered with concretions. X-ray scanning, casting, and other conservation methods are required before study can begin on a concreted artifact. Nonetheless, some artifacts exhibited a cross section of the shape of the nails, and those were nearly exclusively square or rectangular. No round cross-sectioned nails were found on the site. Observation of nail cavities demonstrated that the nails kept a rectangular shape until they narrowed at the tip (fig. 49). The bottom plank of Artifact Nos. 2004-16 and 17 also have the

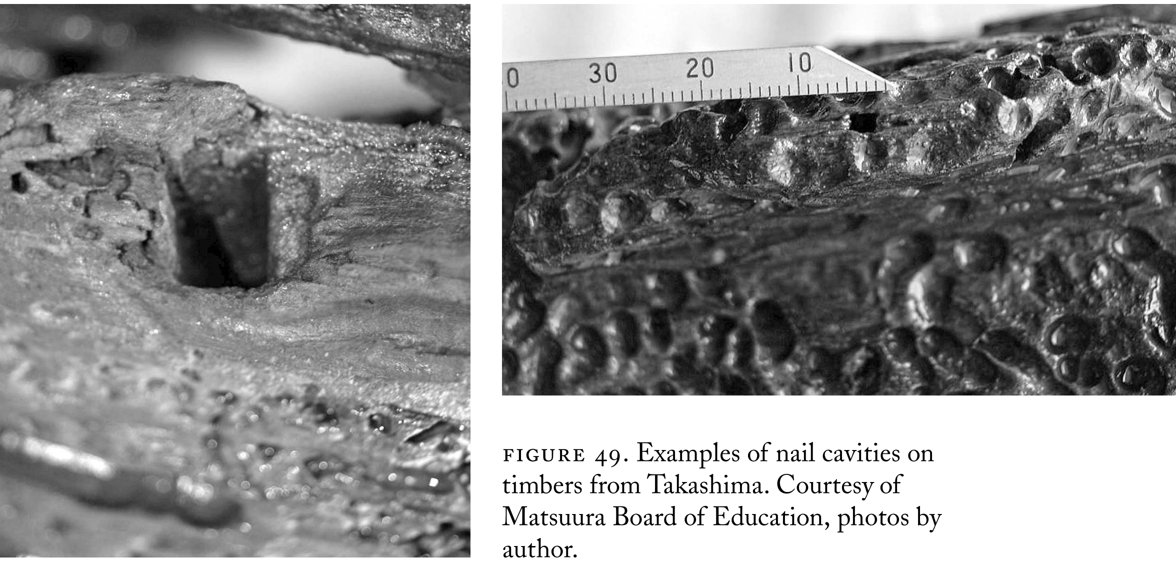

FIGURE 49. Examples of nail cavities on timbers from Takashima. Courtesy of Matsuura Board of Education, photos by author.

pointed tip of the nail emerging from the degraded surface. These findings were useful in reconstructing the shape of the nails found at the site.

The most common nail is a 0.8 to 1 cm square-sectioned nail. Almost all nails are of this type. On large hull components, including bulkheads and planks, a larger 1 to 1.5 cm square nails were used. A third type of much smaller nail, possibly tacks, was found on timbers from the thin plank category. These smaller nail holes are noted on Artifact Nos. 998, 1120, 1341, and 1638. As seen in Artifact No. 1120, the larger nails were also used on the same timber type. A possible wale, Artifact No. 214, also has small nails on its surface. The difference in size does not indicate that the vessel was built in different areas; shipwrights had a selection of nail sizes and used them accordingly. One timber that has a component attached is Artifact Nos. 2003-16 and 17. Nails were used along the seam of its diagonal scarf. The nails used for this purpose are approximately 25 cm long. Even for components that were being connected, it is still difficult to determine the exact length of the nail because it may have held three or more components together. Conclusive evidence is lacking, but with a 1 cm cross section, the iron nails were not likely to be more than 40 cm long before losing holding capacity. On large components, such as planks and bulkheads, a recess was cut into the timber where the nail was to be placed. Artifact Nos. 1439 and 1440 have nails set into a precut recess. Recesses have openings about 5 cm wide.

The results of the analysis of the nails found at Takashima were surprising. On a site that may contain ships built in various areas, one would expect to see variation in nail types. The nails found at the site have little variation in size and shape, indicating that only a small number of ships may be represented at the site. An alternative interpretation is that most of the vessels were built at a few locations in close proximity. The archaeological evidence from other shipwrecks, such as the Ningbo ship as well as both the Penglai No. 1 and No. 2 ships, shows various shapes and types of iron nails. The square nails found at Takashima are similar to some of the nails used for the construction of the Quanzhou and Shinan ships, both built in Fujian Province; the Quanzhou ship, however, showed more variation in the shape and length of nails.[1] In archaeological reports and ethnographic records, nails are often neglected or only briefly mentioned, and often the exact shape is not reported. For this reason, the shape and size of the nails from other East Asian shipwrecks need to be analyzed in extensive detail prior to using the Takashima nails as a tool to identify the origins of the vessels wrecked there.

Joinery without Nails

Fastening without a nail is another important aspect of East Asian shipbuilding technology. The complex wooden joinery methods derive their strength from shaping the wood and fitting it to hold two or more components. The joinery types of Chinese and Korean vessels are briefly reexamined, and more detailed discussion of different joinery types found at Takashima is provided below.

The archaeological evidence of vessels from Fujian Province is surprisingly minimal regarding wooden joinery. The Shinan ship seems to have used mortise and tenon for some components, including bulkheads.[2] Also, the mast step of the Shinan ship was built using locking pins.[3] Evidence from both the Quanzhou and Shinan ships reveals that iron nails were the primary joining methods, with little use of other joining technologies. On the other hand, vessels from the Yangtze River were constructed using more locking mechanisms. The Ningbo ship used iron nails as a primary means to fasten the hull, but mortises and tenons were also used for bulkheads. Numerous pieces of dowels were found on the floor of the shipyard when it was excavated.[4] The Penglai No. 1 and No. 2 ships used mortise and tenon construction for bulkhead connections, along with iron nails.[5] Ethnographic analysis provides good examples of these locking systems. At the Yangtze estuary, many vessel types had deck beams locked into the hull by mortises and tenons.[6] The shipwrights along the upper Yangtze River used locking systems more extensively, such as the use of wooden pins.[7] At Yunnan, mortise and tenon joinery was used to secure planks as well as pegs to secure frames and planks together.[8] Dimensions and details of these joining methods were not recorded.

As discussed previously, Korean shipwrights utilized wooden joinery extensively, and no iron nails were used. The fashioned timber category was created to identify possible timbers from Korean vessels. Nevertheless, this category was not much help in isolating Korean timbers. Because of the unique joinery pattern found in the Korean shipbuilding tradition, a focus on fastening techniques may be of help in finding timbers from Korean ships. As already mentioned, Korean shipwrights used *jangsaks* and *piskas* to hold timbers together. The bottom planks were held by large *jangsaks* going through two or three planks, and the side planks were held by smaller—but still larger than those of western ships—tenons, or *piskas*.[9] *Jangsaks* were about 10 by 5 cm and more or less standardized, but *pisaks* varied in size, usually 5 cm wide and 10 to 20 cm long. The peg was 2 to 2.5 cm in diameter.[10]

The joining methodologies found at Takashima include notches and recesses as well as locks and locking elements (mortise and tenons). A total of 41 timbers were found to have at least one such complex wooden joint. This is 8.17 percent of the total recorded wooden artifacts, significantly smaller in number than timbers with nails. Among the 41 timbers, 23 had nails alongside the wooden joinery. This implies that Chinese shipwrights relied on various technologies to build a vessel, including both nails and wooden joinery. Interestingly, no wooden joinery was conclusively identified as coming from Korea. Koreans used a step joint, tongue-and-groove joint, or butt joint to connect planks; they apparently did not use a diagonal scarf (fig. 50).[11] In addition, most of the planks from excavated Korean ships are usually thicker than 12 cm and less than 25 to 30 cm in width, giving them a blocky appearance. The majority of the Takashima timbers with wooden joinery did not fit this description. Thus, most of the wooden joinery is from Chinese ships wrecked at the site. Currently, there is not yet enough data to separate wood-joining technology by regions because the detailed analysis of wooden joinery has not been the focus of the study of East Asian shipbuilding technology. This is not to say that such an analysis cannot be done; the data collected at Takashima will become a useful tool in the future once more data is collected from other shipwreck sites. Each joinery type is described below.

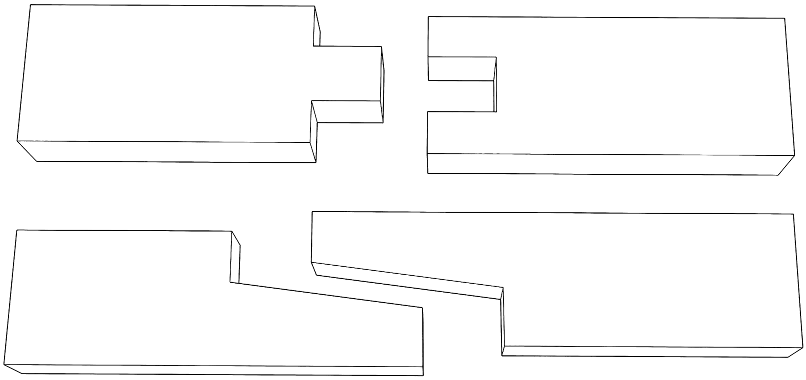

FIGURE 50. Typical joinery on Korean vessels: *above*, tongue-and-groove joint; *below*, step joint. Drawings by author.

A notch is where timbers are joined by cutting part of a timber to create a strong joint. A notch has to be at the edge of the timber, and the opening should not be inside the timber, creating an opening or a hole, but along a plane. The use of notches is found all across Asia, from bulkheads from Chinese vessels to planks from Korean ships. At Takashima a total of fifteen timbers was identified as having a notch, making it the largest wooden joinery type. The size of the notch varies from timber to timber, and thus their functions must be distinct as well. Several timbers with a notch will be described along with the interpretations.

Artifact No. 190 has a small notch of 3.2 cm wide and 2 cm deep and otherwise appears to be degraded curved wood without any other trace of joinery. This timber is close to 1 m in length and about 15 cm in diameter. It may be part of a Korean vessel or a nonstructural component of a Chinese ship. Artifact No. 191 also has the appearance of naturally curved wood. It is 98 cm long and has a small notch on its surface. Both of these examples represent a small notch on a large timber without a trace of other joinery. It is difficult to conjecture how such a small notch functioned on a large timber. Artifact No. 610 and Nos. 2003-8 and 13 (originally one timber) are discussed together because of their common characteristics. These were both part of a large timber; Artifact No. 610 is 10 cm thick, and 32 cm of

FIGURE 51. Artifact Nos. 2003–8 and 13 with notch. Courtesy of Matsuura Board of Education, photo by author.

its width has survived, while Artifact Nos. 2003-8 and 13 are 8 cm thick, and 20 cm of the width has survived. The recess of Artifact No. 610 has survived for about 12 cm, but the rest is broken off. The recess in Artifact Nos. 2003-8 and 13 is a cut 5 cm from the top and more than 20 cm long, indicating that a wider component was placed on top. One interpretation is that these timbers are bulkheads located just below deck level. Perhaps a carling or two was placed longitudinally to support the hull (fig. 51). A mast tabernacle and longitudinal beams were often placed to hold the mast securely, and these notches might be made to fit those beams in place. The thickness of the timbers suggests a lightly built vessel. Another interpretation of these timbers is that they are the planks of a Korean vessel and that this is where a beam was placed. Korean shipwrights utilized two types of beams. One is a typical throughbeam where an opening is made into the plank, and another is a slightly larger hooked beam laid on the recess made on the upper surface of the plank. The hooked beam of the Anjwa ship is about 30 cm wide, and the thickness of the planks is no less than 15 cm.[12] The recesses for the beams on the Talido vessel are 14 to 21 cm, and have much thinner planks of about 11 to 14 cm.

The Talido ship compares well with these finds from Takashima. One problem does exist with this interpretation; both of the timbers are made of camphor wood. This would imply that both of the timbers are from China, and the first interpretation is probably closer to the truth.

Recesses are also known in Chinese ships, and their use was widely practiced in traditional Korean boat-building as well.[13] There are a number of timbers from Takashima that have a recess, but determining their function is not possible. Most of these timbers have small grooves and small notches less than 5 cm wide and 2 cm deep. Several notches were found on what appeared to be a small beam. A small hull component was inserted along these notches, and no strong connection was required. With only one side of the joint and without the corresponding component that is being attached, it is difficult to reach any definite conclusion. These notches were found on timbers with or without nails and in various types of categories. Some of the notches may have been used for removable parts, perhaps deck planking or ceiling planks. Worcester records such practices in ships he has seen in Ningbo and Shanghai.[14] The Hangzhou Bay trader was also equipped with removable beams fitted to a notch made on planks and other components within the hull.[15]

Tenons, treenails, pegs, and other fasteners were often fitted inside the mortises to hold two or more components together. Eight timbers fit this description, and this is the fastener category briefly introduced previously. This category is divided into two groups; one is with a rounded shape, including pegs, dowels, or treenails, the others are more blocky timbers, such as tenons. Artifact Nos. 645, 1028, 1297, and 1811-c are in the rounded group, and Artifact Nos. 828, 1433, 1677, and 1678 are in the rectangular-shaped group (fig. 52).

Artifact No. 645 appears to be a round plug. Both sides are crudely cut, preserving the original shape; the cut is made at an angle, and its function is not clear. The length is 15 cm, with an 8 cm diameter. Artifact No. 1811-c is similar to Artifact No. 645. It is 3 cm in diameter and 5.5 cm long. Both sides are cut; one side is straight while the opposite side is cut diagonally. Both timbers have a treenail-like appearance. These timbers could have been used as fillers for a circu-

FIGURE 52. Possible tenons: *a*, Artifact No. 828; *b*, Artifact No. 1677. Courtesy of Matsuura Board of Education, photo by author.

lar hole to plug an opening made for temporary fasteners or repairs. These round plugs may also have been used to fill the pith or knot the plank assembly, as was done with traditional craft from Okinawa known as *sabani*, where a pith or a knot as well as a weak or rotten section of a wood was cut out and replaced with stronger timber.[16] The word *sabani* derived from the word *sampan*, a close relative of a Chinese small boat.[17] These "plugs" may correspond to the possible treenail holes found on some Takashima planks (Artifact Nos. 202, 883, and 2003–16). However, these possible treenail holes were much smaller than the possible treenails found at the site. Artifact No. 1028 has a circular cross section with the appearance of a treenail, but has a square relief to form a close fit with a component with a rectangular recess. This may be part of a small tool that required a round handle. The timber is 5 cm in diameter and 17 cm in length. Artifact No. 1297 appears to be a treenail 3 cm in diameter with a surviving length of 11 cm. It has a slit, and a nail may have been placed to expand the treenail for maximum holding power, but no records exist for this method in Chinese or Korean shipbuilding.

Artifact No. 828 is the most "tenon-like" fastener. It is 7 cm wide, and 17 cm of its length has survived. It is only 1 cm thick and is heavily charred. One or possibly two round holes were found, and these may be where pegs were inserted to hold the tenon in place. The function of Artifact No. 1433 is unknown. It has a blocky appearance with a maximum dimension of 20 cm, a width of 5.8 cm, and a thickness of 3.5 cm. One section is cut to create an indentation. It was most likely placed inside a rectangular hole to hold two or more components together, like a pin. Artifact No. 1677 is well preserved, with a width of 7 cm, a length of 16 cm, and a thickness of 2 cm. A rectangular hole is placed off-center; the dimensions of the hole are 1.1 by 1.4 cm. If this is indeed for a peg, it means that the joinery was loosely fastened with only one side of the tenon locked with a peg to prevent movement. Artifact No. 1678 has an L-shaped appearance, but originally it may have had a C-like shape. It is 12.5 cm long, 6.5 cm wide, and 1.8 cm thick. The timber is carefully crafted, with a cutout of 2.5 cm. A very small nail is set through the width. Great skill and precision were required to place this nail through the 1.8 cm thick timber, and it demonstrates the great care that the Chinese shipwright took when crafting this timber. It cannot be a part of a large structure; it is more likely part of a small piece of equipment. Artifact Nos. 828 and 1677 may be *pisaks* from Korean vessels, but they appear to be smaller than the excavated examples from Korea. *Pisaks* are fairly large, 2 to 3 cm in thickness and 6 to 10 cm in width, with a diameter for the pegs of about 2 cm.[18] If the timbers are not Korean in origin, perhaps they are tenons from Chinese vessels. Both the Penglai ships used mortises and unpegged tenons along with iron nails to connect the bulkheads.[19] Perhaps these possible tenons from Takashima may be from such vessels, but no timbers from Takashima that feature a mortise have yet been found.

Unique Joinery

This chapter concludes with a brief discussion of unique joineries (*chunam* and "unknown" joinery). *Chunam* is a putty paste widely used by the southern Chinese shipbuilders to prevent shipworms from "eating" the hull.

Chunam is a mix of lime and tung oil, extracted from the seeds of *Aleurites fordii*.[20] This sticky putty is applied to the seams and nails of a vessel to securely fasten each component together as well as to prevent the nails from rusting. In some instances, straw is mixed with this substance to give a different consistency to the mix.[21] The putty is widely used on ships built in China, and archaeological evidence shows that almost all excavated vessels built in southern China had this substance applied, except for vessels built for inland use.[22]

The use of *chunam* was also mentioned by Marco Polo, and this attests to the wide use of *chunam* by Chinese shipwrights in the medieval period.[23] The Quanzhou ship was literally covered with the putty, and it is said that "no nails were left behind" without the putty; every seam, including bulkhead and bulkhead connections, was treated with an ample amount of *chunam*.[24] Despite the wide use of *chunam*, only a handful of timbers from Takashima had a possible trace of the white putty substance. Only two, Artifact Nos. 193 and 918, had direct evidence for the use of *chunam*. Artifact Nos. 949 and 1447 may have had some as well, but this could not be confirmed. An additional twelve timbers had white or gray substances on their surfaces.

Several different scenarios can be considered for the apparent lack of *chunam*. First, *chunam* was perhaps applied to these vessels but has been washed away from the timbers during the past seven centuries. It is possible to assume this hypothesis because the site formation processes at Takashima are unique compared with those at other sites. Takashima is a heavily disturbed site, and all discovered ships were torn in pieces, and perhaps many of the materials excavated were simply "washed up" and deposited near shore during the wrecking process and by subsequent storms over the past seven hundred years. On the other hand, the Quanzhou shipwreck was discovered nearly intact under a silt overburden, with little disturbance after initial deposition. Another interpretation is that most of the vessels at Takashima were built without the use of *chunam*. There may be two reasons for this. First, they were built in areas, such as northern China and inland, where *chunam* was not widely available or where *chunam* was not used. Second, the shipwrights may not have had enough *chunam* prepared for building the vessels needed for the invasion, or perhaps they did not see the necessity of using the putty. Because of the limited number of timbers with putty, no further statement can be made at this stage of research.

FIGURE 53. Possible dovetail cuts on the bulkhead plank from Takashima. Courtesy of Matsuura Board of Education, photos by author.

Unique or unidentified types of joineries were found at Takashima. Several of those joineries are illustrated below, starting with Artifact No. 1863, a possible bulkhead plank that has what appears to be lashing holes. This timber is 187 cm long, 38 cm wide, and 13 cm think. Triangular carvings are visible near a seam. The lashing may have secured the planks together, or a large triangular wooden block might have been inserted. The wood is a variation of chinquapin (*Catastonopsis* sp.); this type of wood was used to construct bulkheads of the Penglai No. 1 and No. 2.[25] There is no other parallel in East Asian shipbuilding traditions. This may become an important artifact when new excavations and undiscovered documents come to light.

The large bulkhead, Artifact Nos. 1439 and 1440 previously discussed, has possible dovetail joints (fig. 53). Dovetail shapes are found on the lower bulkhead plank, but the corresponding bottom pair of the dovetail cuts are lost. These recesses are found at two locations close to the center. They are 4 and 7 cm wide. The actual dovetail joining element was not found. The use of dovetail joints is known in traditional small craft in Japan.[26] Compared with those found on traditional boats, the dovetails from Takashima seem to be too large and too shallow to have had any significant joining strength. The Shinan ship had large dovetail cuts along the keel as well as on the bulkheads; these are considered a remnant of temporary fasteners.[27]

Another interesting piece of joinery was found on Artifact No. 1035. This timber is 97 cm long, 21 cm wide, and 4 cm thick. It likely

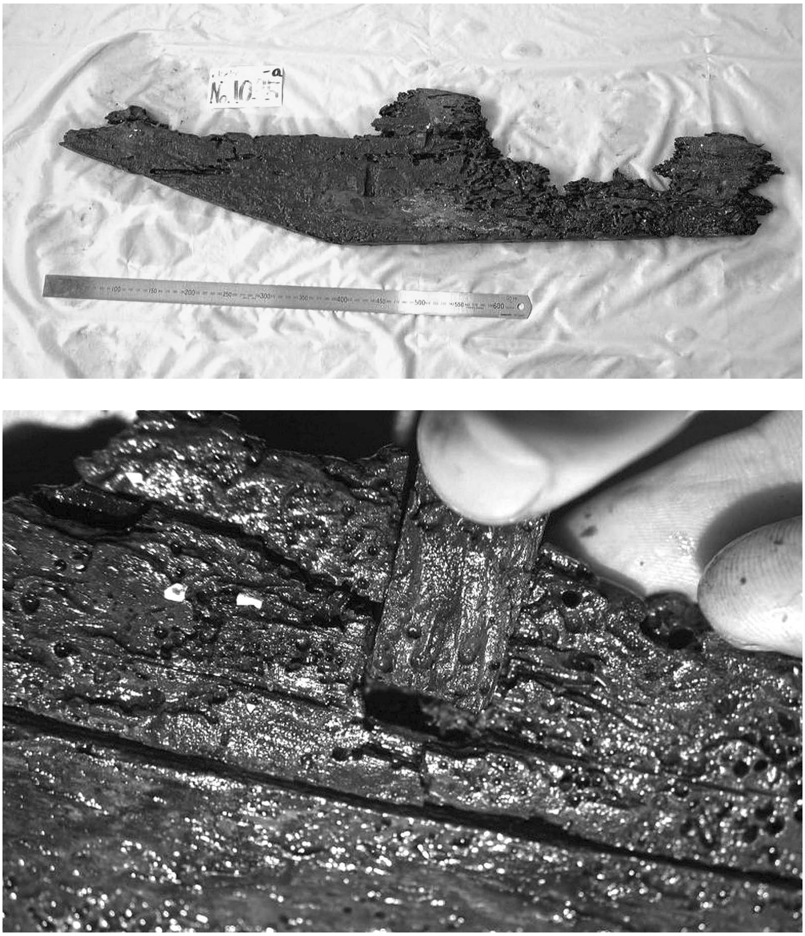

FIGURE 54. Artifact No. 1035 with small plugs. Courtesy of Matsuura Board of Education, photos by author.

belongs to a bulkhead from a small vessel or a secondary bulkhead frame of a vessel. In China bulkheads were doubled at some locations to provide more strength.[28] This timber appears to be too thin to provide any substantial support for a vessel. The timber has small square nails driven diagonally from one side as well as nails from below, which is believed to be part of what was once a doubled structure. One fascinating feature is the presence of small wooden plugs to fill the nail recesses (fig. 54). Each recess is only 1.5 cm wide; it was difficult to find these plugs because they fit tightly into the timbers. After the nail was placed, a small wooden plug was then inserted to fill the gap. Such a practice is seen today in traditional East Asian riverboat building, including dragon boats.[29] All diagonal nails were set into carefully cut rectangular recesses, and wooden pieces were used to fill these holes to make a smooth surface. Despite the fact that this timber now appears degraded, one can observe the detailed care the shipwright took when building this vessel. The original craft might have been built with quality wood and skilled craftsmen. The wood of this timber is identified as *Tsuga* sp., a possible Japanese wood.[30] Although subspecies of *Tsuga* can be found in China, the wood is not commonly used in shipbuilding. Considering that the vessel was lightly built and "engineered" to the details, this may well represent part of a Japanese ship; however, there is no contemporary archaeological record of Japanese ships from the period, and thus the origin of this timber cannot be determined.

Chapter 9 Questions

THE TAKASHIMA SITE poses many questions to be answered. With such a rich history and especially with the dramatic events that took place, the number of questions that the archaeological record may one day answer is limitless. Among the possible questions, there are two questions that people often ask. The first question is regarding Japanese defensive organization and evidence of how well the Japanese fought. The second question concerns the possibility of using hastily constructed and repaired ships and whether these "weak ships" may have been one reason for the failure of the invasion. These two questions relate to an ultimate question—how important was the storm in determining the outcome of the invasion? Stated another way, was human error a factor in the invasion plan? These questions are for now extremely difficult to answer. Therefore, the arguments described below are only "suggestions" as to how archaeology may in the future be helpful in answering these questions.

Japanese Defense

Answering whether the Japanese fought well or poorly during the second Mongol invasion may be one of the most difficult questions to answer. Nonetheless, there are some historical references, together with archaeological inferences, that can be used to solve this mystery. Historically, the Japanese are known as fierce fighters. Several historical documents attest to this during the Mongol invasions. The *Mōko Shūrai Ekotoba* scroll, already described, illustrates the fighting deeds of Takezaki Suenaga, who was eager to fight the Mongols, and the scroll also depicts him engaging in battle with valor. This illustrated scroll is suspiciously silent regarding the storm. Thomas Conlan, in his masterfully titled book, *In Little Need of Divine Intervention*, discusses how the Japanese samurai fought well and suggests that the Japanese did not need a great typhoon to win the war.[1] Conlan's work is also an excellent commentary for the scroll epigraphic and written record that is available in English. The first Mongol invasion can also be used as a possible reference for how the Japanese fought during the second invasion only a few years later. Ōta describes the failure of the first invasion in 1274 CE as the lack of organization by the Mongolian troops based on several passages in historical accounts.[2] The *Yuan Shi* notes that "the troop was not organized" and "all the arrows had been used."[3] The sudden retreat of the first invasion, however, also suggests that the Japanese defended the territory well. After the invasion, Japanese leaders wasted no time in preparing for the next attack and even planned attacks against Korea.[4] These historical sources suggest that the Japanese fought well and perhaps there was really no need for the storm.

Perhaps one important factor that needs to be considered when talking about the Mongol invasion of Japan is the defensive walls that the Japanese made in between the two invasions. During the first invasion, most of the battle took place on land while the second invasion was fought on water. Perhaps it may be said that the Mongols could not land their troops and were forced to stay on board the ships. The walls that the Japanese built show up prominently in the above-mentioned scroll. The Eastern Army, which arrived in Japan, could not land, perhaps because of these walls, and had to wait for the Southern Army to arrive. One reason why the Mongols attacked an unpopulated part of Japan was that they were prevented from landing because of these walls and needed a plan to find their way behind the walls. Imari Bay may have been a perfect place to initially establish a controlled landing and force their way gradually inland. When invading another country across the sea, especially in premodern warfare, one rule is to take control of a piece of land in the invading territory. Historical documents clearly state that the Mongols could not do so and were met with the storm. Had they been able to take control of a piece of land, the storm might not have caused such havoc to the invading forces. The historical accounts agree that the Japanese samurai fought well, aided by the walls they constructed. One wall is clearly depicted on the *Mōko Shūrai Ekotoba* scroll (fig. 55). Also, the walls that they built have been excavated in many areas along Fukuoka Bay (fig. 56). Perhaps the real significance of the second Mongol invasion of Japan is that the enemy failed to reach firm ground and establish a base of operation. The fleet was gathered and engaged in naval skirmishes, but the soldiers never successfully landed. A typhoon or two will pass through Kyūsyū in any given year, and the invasion coincided with the peak of typhoon season. Therefore, it was ultimately (although indirectly) the Japanese defense that determined the outcome of the invasion. Any evidence of Japanese defense strategy is thus an important clue to the real story of *Kamikaze*.

From Takashima, the evidence of Japanese defense is not as easy

FIGURE 55. Defensive wall depicted on the *Mōko Shūrai Ekotoba* scroll. Courtesy of the Japanese Imperial House Museum.

FIGURE 56. Partially reconstructed defensive wall in Fukuoka. Courtesy of Fukuoka Board of Education, photo by author.

to see as the remnants of walls. Nonetheless, there are some possible clues. The first clue is charred timbers. At least thirty-five of the timbers were charred or burned. Most of these charred timbers are from the unidentifiable, featureless, or fashioned timber categories and are seemingly ships' components. Some timbers were only partially charred, while some were burned throughout. Perhaps these charred timbers are parts of ships destroyed by Japanese fire attacks. There is no direct evidence to prove this point, but it is a likely scenario. One timber that needs to be addressed is Artifact No. 1394, a nearly complete windlass stand described previously. A substantial amount of wood survived from this timber and is well preserved, despite the fact it is heavily burned. A windlass is important shipboard gear and, as seen on the *Mōko Shūrai Ekotoba* scroll and other iconographies, was located at deck level. This is exactly where Japanese samurai would have started a fire. If the fire was an accident, it may have started in the galley. The artifact is heavily burned, and it leaves little doubt but that the ship burned thoroughly and thus may have sunk from the fire. Having evidence that at least one ship sank from a fire does not prove the Japanese fought well. Nonetheless, it is tangible evidence that suggests a possibility and opens the door to further research.

Hastily Constructed Vessels?

Ever since I started analyzing the timbers, many of my colleagues have asked this question. Why were so many ships lost during the storm? Were there any human errors, such as bringing poorly constructed or badly repaired ships? I have been asked if it is true that the ships were deliberately constructed to a lower standard as a means of boycotting the newly established Yuan rule. At a first glance, the apparent degraded nature of the timbers from the Takashima site seems to confirm such a theory. Nevertheless, the evidence of faulty construction is extremely difficult to detect, and a thorough understanding of the shipbuilding technology of all of East Asia is required before making any judgments.

One excellent example to illustrate why the knowledge of East Asian shipbuilding is essential is the mast step discovered at Takashima. Artifact No. 193 appears to be in poor condition and made without much attention to detail. Indeed, the two rectangular holes where tabernacles were placed are not aligned, and the shape is not symmetrical. A third hole, which is a natural opening of the wood, suggests that the shipwright who made this step did not place much importance on selecting a high-quality wood. Some may view this as evidence of hasty preparation for the invasion. However, this is not the case. One must understand the Chinese shipbuilding tradition to comprehend this point.

The mast step sat at the bottom of the hull and was laid in a transverse direction. The step was abutted to a bulkhead, and the mast, tabernacles, bulkhead, and often carlings or transverse beams were securely fastened to each other. The weight of the mast was distributed along the tabernacles and to the bulkhead. The bulkhead spread the weight and stress of the mast evenly throughout the hull. In this method, no one point received the stress of the mast; instead the stress is distributed across the hull. A mast step plays an important role in a traditional western ship, in which the heel of the mast sits directly on the mast step and the mast step receives all its weight and stress (fig. 57). Compared with this method, the Chinese way of distributing the stress across the hull is a logical means of carrying more

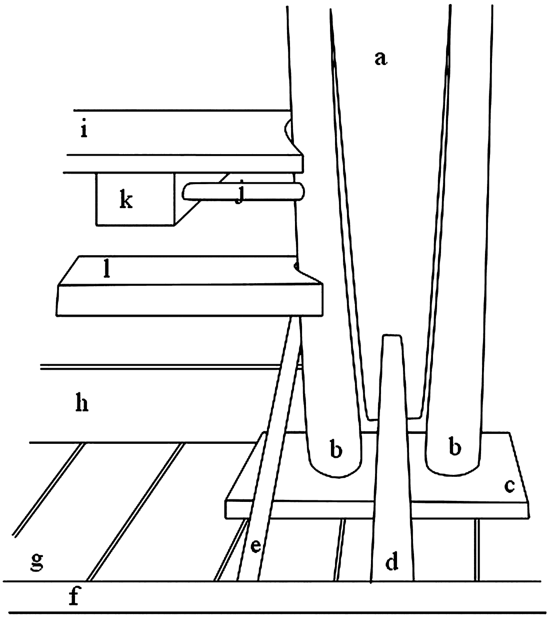

FIGURE 57. Mast configuration found on Hangzhou Bay trader: *a*, mast; *b*, mast partners; *c*, mast partners' step; *d*, mast wedge; *e*, partner guide; *f*, rib; *g*, floorboards; *h*, bulkhead; *i*, sailing beam; *j*, partner chock; *k*, longitudinal/carling; *l*, partner bracket (after Waters 1947, fig. 6). Reprinted with permission.

weight than western ships of a similar size can. Furthermore, western ships required standing rigging to hold the mast in position, thus limiting the movement and direction of the sails. Chinese ships did not require standing rigging to hold the mast stable. Mast steps in Chinese ships play a minor role in holding the mast in place, and the real strength is the arrangement derived from the bulkhead.[5] Many of the traditional vessels of the Yangtze River, described by Worcester, used carved branches to secure tabernacles; in fact, for some vessels the heel of the mast did not touch the mast step (fig. 58).[6] Thus, what seems to be a poor-quality mast step cannot be taken as evidence of poor craftsmanship. As this example suggests, what may seem to be crude to the western shipbuilders was perfectly fine for Chinese shipwrights, and vice versa.

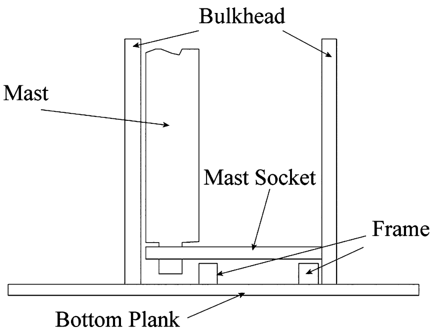

FIGURE 58. Simple "mast step" found on traditional rivercraft (after Worcester 1971, 476). Reprinted with permission.

Perhaps there were few faulty ships or none. The evidence is for now too scanty to draw a definite conclusion, but it is logical to assume that many of the ships were either well built or well repaired. A wooden tag discovered at Takashima, suggesting evidence of repair, has been previously mentioned (fig. 59). This tag notes that "something" was repaired and inspected. It is also known from historical records that many merchant ships and pirate ships were gathered for the invasion.[7] Some of these vessels may have required a repair. Several artifacts from Takashima actually show evidence of repair and recycling. Artifact No. 1880, for example, shows multiple nails placed in close proximity, less than 2 cm apart from each other (fig. 60). Other timbers have nails of different sizes driven in from various directions. Such a practice may be attributed to reuse of a timber. Although the erratic array and unusually high number of nail holes do not automatically prove that the section has been repaired, at least six or seven timbers exhibited such features that cannot be explained otherwise. Among these timbers with possible repairs, many of them were from the railing timber category. This makes sense, because a plank can be cut in half and made into a railing and as such does not have to be shaped from a freshly cut timber. Planks and bulkheads were most likely built from new timber. The evidence reinforces the idea that many of the ships were strongly built but that corners were cut where it made no difference. The government inspection also insured that no poorly constructed vessel left the harbor.

FIGURE 59. Wooden tag discovered at Takashima. Courtesy of Matsuura Board of Education.

FIGURE 60. Artifact No. 1880 with evidence of possible recycle/repair. Courtesy of Matsuura Board of Education, photo by author.

Conclusion

THE SECOND MONGOL invasion of Japan, in 1281, played an important role in shaping the maritime history of East Asia and Japan. The remains of the ill-fated fleet discovered at Takashima Island have provided significant information regarding how the invasion was organized. This is the site where the legendary storm now known as *Kamikaze*, or "divine wind," crushed the Mongol armada of 4,000 ships. The archaeological discovery of the remains of some of the fleet not only reveal details of the events, but also shed light on the shipbuilding technology of East Asia at that time. This study represents a first step toward answering some of the topics not previously addressed because of the lack of available evidence. One of these topics pertains to the origins and types of vessels involved in the invasion using the physical remains of these vessels. However, archaeological evidence tells only part of a story, and various other types of evidence must also be consulted. The most essential question I wanted to answer was how the invasion was organized—what types of vessels were used, where the ships had been built, and other similar questions.

An analysis of the historical documents clearly suggests that the fleets that Khubilai Kahn dispatched to Japan were divided into functions and were well organized. The Eastern Army used flat-bottom vessels built in Korea as landing craft to attack the Japanese forces and gain initial control of a small piece of territory on mainland Japan. The Southern Army's fleet consisted of V-shaped cargo ships built in Fujian Province for carrying provisions as well as rounded-hull and flat-bottom vessels made along the Yangtze River and functioning as reconnaissance and miscellaneous craft. The smaller vessels supported and protected the large supply ships. Their tasks were also to support, establish, and maintain a base for the invasion. These three types of vessels were all necessary components of the invasion plan. The historical, iconographical, ethnographical and archaeological evidence all points to the fact that ships built in these areas were well suited for such specific tasks. Khubilai and his advisors seem to have studied the natural resources, people, and ships of the areas he subjugated and then used them to attack another land. Despite his effort, his dream of conquering failed.

Considering the size of China and its diverse environment, various shipbuilding traditions have existed. Shipbuilding in medieval China relied on the hull-bottom elements to form the basic shape of the vessel and on bulkheads to support the hull. Oceangoing craft built in Fujian Province and inland craft built in the Yangtze River area differed in the bottom structure. In Fujian Province, the bottom consisted of the wide keel, heavy garboards, and bottommost bulkhead timbers. In the Yangtze River area, the bottom planks served as the basis for both flat-bottom and rounded-hull boats. Korean ships were made according to a completely different shipbuilding philosophy. Korean shipwrights used no nails to construct a hull but used wooden joinery extensively. The archaeological evidence from shipwrecks provided the most useful information while iconographic, historical, and ethnographic records were consulted when data appeared useful.

Prior to the discussion of timbers, some nontimber artifacts recovered from the site were briefly analyzed. Only a small number of artifacts were identified as originating in Korea. Most of the materials were from southern China. The artifacts appear to represent some class distinctions. The majority of the artifacts were crudely made storage jars for daily use by common soldiers, but others were reserved for officers. The ceramic remains clearly exhibit this pattern. Weapons and other metal items still require this analysis, but they are in the process of conservation, which will take several years to complete. The lack of Korean artifacts was no surprise because historical documents state that most of the Korean ships were not harmed during the storm and safely sailed back to Korea. Also, the types of artifacts found show characteristics of a military expedition—it is clear that the vessels wrecked at Takashima carried no luxury goods, except for some personal items of high value that some officers may have carried.

The aim of my research was to study the timbers recovered from Takashima in order to determine if these different types of vessels—large Fujian V-shaped vessels, middle and small Yangtze Valley rounded-hull vessels, and small Korean flat-bottom ships—could be found at the site. Takashima is an extremely difficult site because of the disturbed nature of the archaeological deposit. More than 500 timber fragments were recovered, and these fragments could be from ships built in Korea, China, or perhaps even Japan. Almost all the timbers were recovered in poor condition, and this made analysis difficult. However, at the same time, many timbers discovered at Takashima exhibited features that revealed interesting functions. By isolating the few timbers that share similar characteristics, it was possible to focus on specific aspects of shipbuilding technologies. The result of this timber database suggests that many of the timbers belonged to small vessels, most likely from the Yangtze River area. While not representing a significant portion of the remains, at least one large V-shaped vessel built in Fujian Province was also present. No timber found could be definitely identified as originating in Korea, but several timbers matched characteristics similar to vessels from Korea. This concurred with the historical documents and other artifacts found at Takashima.

The species identification of wood also provided an interesting insight into the ships that the Mongols brought and the naval organization at the time. Particularly, the bulkhead timbers were all made of camphor wood, indicating that shipwrights from southern China were strict on making the hull with a well-selected wood. In addition to the bulkheads, the firewood that the invaders brought was mostly of pine. Such wood is excellent to use on board the vessels for cooking and for communication as well. Although the data is still far from convincing, the absence of oak and pine in hull structures and the abundance of camphor wood and China fir implies that the majority of the ships may have come from China and not from Korea.

The study of joinery posed many questions for future research. Another site like Takashima, which contains the remains of a large number of vessels built in different regions, should yield many types of joineries, both metal and nonmetal fasteners, and various methodologies employed for fastening a vessel's components together; however, the Takashima site thus far lacks this expected variation in joinery. From the number of the timbers with nail marks, it is apparent that the use of nails was the preferred method of joinery used on the vessels found at Takashima. Nails showed little variation in size and shape, indicating that perhaps only a small number of ships are represented at the site, or that most of the vessels found at the site were built in a relatively small geographic area, perhaps in government-operated shipyards. No timber can be confirmed to have derived from a Korean vessel based on the study of joinery. This suggests that most of the timbers found at Takashima are from ships built in China, perhaps along the Yangtze River and, in some instances, in Fujian Province.

Besides the detailed analysis of timbers, I have tackled some other questions, namely, how well the Japanese defended the country and the possibility of the presence of hastily constructed ships. Although archaeological evidence is somewhat difficult to interpret, it appears that there is some evidence of Japanese defense. Charred timbers indicate that the Japanese used fire to repel the enemy fleet. For the evidence of construction shortcuts, several timbers exhibit traces of repair and reuse. This evidence, although present at the site, does not provide conclusive answers for what happened 700 years ago. Why did the fleet fail in its purpose? Although these questions are intriguing, the aim of my research was to identify the origins and types of vessels used for the second invasion. Therefore, the reason or reasons for the failure of the invasion are beyond this study. Further study, both with the archaeological record and with historical documents, with particular attention to such questions, is required.

This research revealed that despite the heavily disturbed underwater site, much information can be gleaned. First, the ships that the Mongols brought to Japan were not a conglomerate of all ship types but most likely were organized by function. Bringing riverboats was part of a well-planned strategy because these vessels played a major role. Second, most of the remains discovered so far from the Takashima site most likely derived from small watercraft from the Yangtze delta, but at least one large Fujian-built vessel was present. Third, the ships that sank were not all poorly built or were crushed because they were all riverboats. Some of the vessels were strongly built and some were repaired, but having been repaired should not be taken as evidence for weak ships. Finally, this research has shown the importance of detailed analysis of shipwreck remains from other sites across East Asia. Once such information becomes available, the true significance of the past and future research at the Takashima underwater site will be revealed.

As stated, it appears that Khubilai (and his military officials) had a strategy in mind. First, they had to take control of a piece of land, and supplies must be shipped to maintain this base. They could slowly advance from here and perhaps compel the government to submit, using their undefeated cavalry units as a threat to annihilate them. To accomplish this, the ships that the Mongols gathered had specific tasks to be performed. A large cargo vessel was necessary, as were smaller watercraft. Smaller ships, perhaps somewhat unfitted for great typhoon winds, were necessary for the invasion. Without the smaller, shallow-hull vessels, the Mongols would not have had a means to disembark their horses and troops.

The archaeological project at Takashima is still ongoing after thirty years of research. The information provided herein is only a small part of a much larger research program. Nonetheless, this research on timber recording and analysis can be considered a turning point in the history of research at Takashima. This is because all research so far has focused on giving description of artifacts found—simply to record what was found—and not much attention has been paid to the timber remains and the interpretation of the collected data. The interpretation presented is still far from being conclusive, but it sheds light on possible directions for further research to follow.

As mentioned at the beginning of this book, the large vessel discovered in 2011 has not been analyzed or recorded in detail. Initially, I had wished to include the analysis of the discovered hull in this research; however, after careful consideration, I realized that I should not wait but let the public know what I had found so far. Considering the possible large number of vessels that may be still buried beneath the waves, there is little reason to rush to excavate everything we find. The research on the Mongol invasions of Japan is a fascinating topic to follow at least for the next decade or two. Perhaps the next generation of archaeologists will be able to analyze the more complete hull. I hope this study may be a guide for them to follow.

Appendix A Time Line of Events

	China/Mongol	Korea/Japan
960	Song dynasty established	
1019		Jurchen attacked Japan
1115	Jurchen established Jin dynasty	
1127	Southern Song dynasty established	
1162	Birth of Genghis Khan	
1192		Kamakura Bakufu established
1215	Birth of Khubilai Khan	
1227	Death of Genghis Khan	
1231		Ogedai Khan invaded Korea
1267		Mongol emissary reached Japan
1271	Yuan dynasty established	
1273		Revolt of Sambyolcho ended
1274		First Mongol invasion of Japan
1279	Fall of Song dynasty	
1281		Second Mongol invasion of Japan
1292		Japanese merchants active in China
1333		Fall of Kamakura Bakufu
1368	Ming dynasty established	
1392		Fall of Goryeo dynasty in Korea
1405	Zheng-He's expeditions	
1433	Overseas expeditions halted	

Appendix B Timber Database

BEAMS

Artifact No.	Rank	Length*	Width*	Thickness*	Wood Species
189	2	167.5	16	9.5	*Cinnamomum camphora*
195	2	63.5	7.5	7.5	*Cinnamomum camphora*
885	3	97	11	10	*Quercus* sp. *(Cyclobalanopsis)*
959	1	82	9	9	*Ulmus* sp.
1315	3	95	9	6	*Pinus* sp.
1316	4	65	11	4	*Pinus* sp.
1394	2	68	8	5	*Pinus* sp.
1436	4	50	3	NA	*Taxodiaceae*
1627	5	50	NA	NA	*Pinus* sp.
885-b	3	50	7	4	*Quercus* sp. *(Cyclobalanopsis)*
2003-1	2	60	9	5	*Pinus* sp.
2003-21	3	56	7	3	*Taxodiaceae*
2004-25	3	64	10	6	*Cunninghamia lanceolata*

*All measurements are in centimeters.

Brief Descriptions (Beams)

189	Possible square cross section, no nails
195	Long, somewhat rectangular cross section, no nails
885	Square cross section, no nails, seems to have a notch at one end
959	Possible throughbeam with a different thickness at one end
1315	Rectangular cross section, no nails
1316	Degraded but rectangular cross section, no nails
1394	Rectangular cross section, no nails
1436	Degraded, possible rectangular cross section, may be included in fashioned timbers
1627	Degraded, possible rectangular cross section, no nails
885-b	Slightly warped timber with square cross section, no nails
2003-1	Rectangular cross section, one nail, original width preserved, has a notch
2003-21	Rectangular cross section, no nails
2004-25	Rectangular cross section, no nails

BULKHEADS

Artifact No.	Rank	Length*	Width*	Thickness*	Wood Species
207	4	18	15	7.5	*Cinnamomum camphora*
221	2	155	19	4.5	*Cinnamomum camphora*
909	2	325	45	12	*Cinnamomum camphora*
918	2	NA	NA	NA	*Cinnamomum camphora*
949	2	320	45	16	*Cinnamomum camphora*
1035	2	97	21	4	*Tsuga* sp.
1142	1	47	9.5	9	*Cinnamomum camphora*
1428	3	60	21	8.6	*Cinnamomum camphora*
1439	1	465	49	16.5	*Cinnamomum camphora*
1440	1	570	59	17	*Cinnamomum camphora*
1609	5	47	NA	NA	*Pinus* sp.
1860	4	75.3	16	5	*Cinnamomum camphora*
1866	2	140	26	10	*Pinus* sp.
1428-b	3	50	13	NA	*Cinnamomum camphora*
2003-8	2	150	20	8	*Cinnamomum camphora*

*All measurements are in centimeters.

Brief Descriptions (Bulkheads)

207	Possible small portion of an edge of a larger bulkhead
221	Possible bulkhead of a small boat? but the angles on both sides are different
909	Possible bulkhead or plank
918	Part of Artifact No. 909, with possible *chunam*
949	Most likely a bulkhead; seems to have corrosion on surface that appears to be stiffeners
1035	Very thin bulkhead or bulkhead support, with small wooden plugs to fill nail cavities
1142	Possible bottommost bulkhead, perhaps near the stern?
1428	Degraded possible bulkhead, diagonal nails placed from both sides, from top to bottom
1439	Lower section of the 6 m long bulkhead plank, with possible dovetail joints?
1440	6 m long bulkhead, with two notches, found connected to Artifact No. 1439
1609	Highly degraded but possible bottommost bulkhead with nails coming in from sides
1860	Highly degraded timber, but seems to have diagonal nails placed from both sides
1866	Possible bulkhead of a smaller vessel or possibly a plank
1428-b	Highly degraded and curved, has a flat original surface
2003-8	Possible bulkhead, has a rectangular notch for carling at top

THIN PLANKING

Artifact No.	Rank	Length*	Width*	Thickness*	Wood Species
236	2	NA	11	2.5	*Cunninghamia lanceolata*
614	2	33	10	1.5	*Pinus* sp.
844	3	42.2	7	1.5	*Ulmus* sp.
883	2	44	14	2.5	*Cunninghamia lanceolata*
998	2	115	20	2.5	*Cunninghamia lanceolata*
1060	2	69	17	4	*Taxodiaceae*
1120	1	50.5	20.5	3.5	*Pinus* sp.
1146	4	19	10	2	*Cinnamomum camphora*
1271	4	NA	NA	0.5	*Pinus* sp.
1341	4	35	11	3	*Pinus* sp.
1638	2	72.2	13.2	2.22	*Pinus* sp.
1644	4	38	5.5	2	*Pinus* sp.
1857	4	33	5	2	*Taxodiaceae*
1859	1	51	24.3	4.01	*Pinus* sp.

*All measurements are in centimeters.

Brief Descriptions (Thin Planking)

236	Possible deck planking or sheathing
614	Charred thin plank with no nails, may be a sheathing
844	Thin plank, no nails
883	A thin plank with a round hole going through the thickness
998	Possible sheathing with two small nails
1060	Possible panel, deck planking, or sheathing
1120	Possible panel, deck planking, or sheathing
1146	Degraded possible deck planking with several nails
1271	Thin piece of timber, may be deck planking or sheathing
1341	Possible panel, deck planking, or sheathing
1638	Possible panel, deck planking, or sheathing
1644	Degraded panel, deck planking, or sheathing
1857	Small fragment of thin plank
1859	Thin plank, close to original shape, with several nails

HULL PLANKS

Artifact No.	Rank	Length*	Width*	Thickness*	Wood Species
201	4	55	25.5	12	*Cinnamomum camphora*
202	2	64	12	5.5	*Cinnamomum camphora*
315	4	150+	19	13	*Cinnamomum camphora*
316	4	105	17	8.5	*Cinnamomum camphora*
875	3	60.5	17.5	10.5	*Cinnamomum camphora*
889	4	52	8	3.5	*Cupressaceae*
1364	2	64	11.5	5.5	*Cunninghamia lanceolata*
1456	2	41	42	11.5	*Cinnamomum camphora*
1852	2	92	14	4	*Cupressaceae*
1854	4	80	17	NA	*Cunninghamia lanceolata*
1317	4	NA	NA	6	*Cinnamomum camphora*
1047-a	4	98	28	NA	*Cinnamomum camphora*
838-b	5	46	15	3.5	*Pinus* sp.
2003-16	2	88	22	8	*Taxodiaceae*
2003-17	2	40	8	5	*Pinus* sp.

*All measurements are in centimeters.

Brief Descriptions (Hull Planks)

201	Degraded large timber with nails set in angle, possible plank
202	Possible plank but may be a bulkhead, similar to Artifact Nos. 2003-16 and 17
315	Highly degraded plank, with nails set diagonally, similar to Artifact No. 838-b
316	Highly degraded possible plank
875	Degraded, flat timber with nail holes and concretion, a round hole going through the thickness
889	Highly degraded plank with diagonally placed nails
1364	Possible broken plank, nails set next to each other for possible repair?
1456	Close to original shape, part of a large plank or possible bulkhead
1852	Thin and long plank or bulkhead with several nails in random pattern
1854	Degraded wood with concretions, appears to be a plank
1317	Highly degraded and fragmented, but may be remnant of possible plank scarf
1047-a	Large degraded timber with two concretions, appears to be part of a larger plank
838-b	Highly degraded possible plank, similar to Artifact No. 315
2003-16	Upper section of plank with nails and scarf, connects to Artifact No. 2003-17
2003-17	Lower section of plank with nails and scarf, connects to Artifact No. 2003-18

RAILINGS

Artifact No.	Rank	Length*	Width*	Thickness*	Wood Species
198	3	28.5	6.5	7	*Cinnamomum camphora*
639	2	82.5	6	6	*Taxodiaceae*
836	2	67	6	4	*Cunninghamia lanceolata*
869	4	38	6.6	7.8	*Pinus* sp.
972	3	NA	9	2	*Ulmus* sp.
993	3	44	4.2	1.5	*Cunninghamia lanceolata*
1008	2	87	5	4	*Cryptomeria* sp.
1092	2	44.5	6.7	4.2	*Cunninghamia lanceolata*
1132	3	40	7	4	*Cryptomeria* sp.
1171	4	52	NA	NA	*Cunninghamia lanceolata*
1220	4	23.5	10.5	5	*Pinus* sp.
1344	3	66	6	NA	*Castanopsis* sp.
1356	4	20	7	5.5	*Cinnamomum camphora*
1443	3	63	4.3	4.3	*Cunninghamia lanceolata*
1448	3	21.7	8.8	4.5	*Pinus* sp.
1477	3	27	8	7	*Cinnamomum camphora*
1636	2	55	6	3	*Taxodiaceae*
1672	2	30	5	3	*Cunninghamia lanceolata*
1684	2	45	8	6	*Pinus* sp.
1686	2	25	7	4.4	*Cunninghamia lanceolata*
1694	2	51	8	4	*Cupressaceae*
1696	2	50	8	4	*Cunninghamia lanceolata*
1697	2	35	4	3	*Cunninghamia lanceolata*
1703	2	32	7	6	softwood?
1725	3	27	6.5	4	*Cunninghamia lanceolata*
1748	2	62	6	3	*Cunninghamia lanceolata*
1830	3	34	2.5	NA	*Cunninghamia lanceolata*
1864	4	86	6	5	*Cunninghamia lanceolata*
1880	3	81.5	7.3	4.34	*Taxodiaceae*
1827	4	18	7	3.2	*Pinus* sp.
848-b	2	40	8	7	*Ulmus* sp.
2003-40	3	45	13	5	*Cunninghamia lanceolata*
2003-45	4	26.5	4	3	*Lauraceae*

*All measurements are in centimeters.

Brief Descriptions (Railings)	
198	Degraded timber with multiple nails in random order
639	Neatly cut long and rectangular timber with equal spacing of nails, a possible stiffener?
836	Possible railing with one round hole
869	Most likely a railing type that has a scarf/diagonal cut?
972	Degraded timber with several nails
993	Thin, but nails placed in line
1008	Thin, well preserved, but broken, nails in line
1092	Railing-like timber with two round holes
1132	Highly degraded possible railing with two nails
1171	Highly degraded timber, with three sets of two nails at close intervals
1220	Highly degraded, but preserving the original width
1344	Appears to be driftwood, but shows a modified edge and a possible nail hole
1356	Small timber fragment that appears to be part of a railing, with nails placed in close proximity
1443	Thin possible railing type, with four nails in line
1448	Possible railing, with original width preserved
1477	Possible railing with a diagonal hooked scarf with nails going through
1636	Long, thin, and slightly warped railing with a nail
1672	Original surface preserved on one face, with multiple small nails
1684	Degraded possible railing, with a possible scarf and no nail
1686	Railing-like shape, but with nails driven diagonally from the side
1694	Degraded possible railing, with nails
1696	Broken possible railing, with nails
1697	Possible railing with almost square cross section, with a nail
1703	Degraded possible railing, with many nails placed in order and in line
1725	Degraded possible railing, one surface well preserved
1748	Degraded, but typical railing with many nails in line
1830	Degraded fragments with a nail
1864	Three fragments that go together, could be a railing, but shows complex nailing pattern
1880	Possible thin railing, many nails in various directions from repair/reuse
1827	Degraded and broken timber, but may be a railing
848-b	Well-preserved possible railing, with a scarf and rectangular cut
2003-40	Degraded possible railing, with several nails
2003-45	Degraded but rectangular cross section, with several nails

FASHIONED TIMBERS

Artifact No.	Rank	Length*	Width*	Thickness*	Wood Species
90	4	57.5	24	21	*Cinnamomum camphora*
190	3	93	15	15	*Pinus* sp.
191	2	98	6	6	*Cinnamomum camphora*
199	4	63	10	10	*Cinnamomum camphora*
255	4	51	5	5	*Pinus* sp.
304	4	73	31	13	*Cinnamomum camphora*
355	2	55	9	6	*Dalbelgia* sp.
610	3	72	32	10	*Cinnamomum camphora*
842	5	50+	NA	NA	NA
874	3	50+	NA	NA	*Cinnamomum camphora*
876	4	75	14	14	*Pinus* sp.
1005	5	50+	20+	NA	*Cinnamomum camphora*
1011	3	NA	NA	NA	*Ulmus* sp.
1013	5	50+	20+	NA	*Cinnamomum camphora*
1032	4	50+	NA	NA	*Pinus* sp.
1081	4	50+	20+	NA	*Cinnamomum camphora*
1140	4	50+	NA	NA	*Tectona grandis*
1396	3	62	20	NA	*Pinus* sp.
1401	3	66	20	3.5	*Cinnamomum camphora*
1446	4	66	6	NA	*Dalbelgia* sp.
1501	5	100+	NA	NA	*Pometia* sp.
1502	5	50+	20+	NA	*Pometia* sp.
1851	4	100+	50+	NA	*Cinnamomum camphora*
1853	5	100+	20+	NA	*Cinnamomum camphora*
1855	4	50+	20+	NA	*Cinnamomum camphora*
1867	5	50+	NA	NA	*Quercus (Cyclobalanopsis)*
1451, 1452, 1453, 1454	5	100+	50+	NA	*Cinnamomum camphora*
2003-14	4	50+	10	4	*Lauraceae*
2003-29	4	55	5	NA	*Pinus* sp.

*All measurements are in centimeters.

Brief Descriptions (Fashioned Timbers)

90	Degraded, featureless, teredo-infested, shaped timber?
190	Round large timber with a rectangular cut or a notch
191	Well-shaped rod with a notch, function unknown
199	Degraded large timber
255	Degraded and broken timber
304	Highly degraded naturally shaped wood with a shaped notch
355	Split log without a nail
610	Part of a large timber having a large notch, may be a bulkhead and a notch for a carling
842	Large block of possible driftwood
874	Degraded timber, with rectangular cross section, appears to be a type of plank but with no nails
876	Large naturally curved timber, no nails
1005	Large degraded fragment of a plank or bulkhead, but no nails found, part of larger component?
1011	Several fragments of degraded timber, one of them may have a rectangular/square scarf?
1013	Large fragment of a plank or bulkhead, but no nails
1032	Teredo-infested, possible thick naturally curved wood
1081	Possible fragment of a plank or bulkhead, but no nails
1140	Highly fragmented timber in multiple fragments, no nails
1396	Degraded wood without a feature
1401	Degraded large block of wood, no nails
1446	Degraded, thin and long timber
1501	Degraded fragments of a larger timber
1502	Degraded wood, perhaps a plank, but no feature
1851	Degraded, large flat timber with no feature
1853	Large plank like timber with no nails
1855	Large plank-like timber with no nails, might have a straight cut at the side? (butt-joined) plank?
1867	Degraded wood, no feature
1451, 1452, 1453, 1454	Large fragments of plank or bulkhead, with no nails
2003-14	Degraded fragments of larger timber
2003-29	Degraded, long, naturally curved timber

WALES

Artifact No.	Rank	Length*	Width*	Thickness*	Wood Species
214	1	166	14.5	6	*Cinnamomum camphora*
317	3	116	25	11	*Cinnamomum camphora*
354	2	51	8.5	4	*Cunninghamia lanceolata*
362	2	50	10	7	*Ulmus* sp.
856	2	56.5	13.5	6.5	*Ulmus* sp.

*All measurements are in centimeters.

Brief Descriptions (Wales)

214	Typical wale with nails in several directions in line
317	Cross section may be split log, like a wale, with bark still attached and with several nails
354	Rounded cross section, five nails set in various directions
362	Possible railing with multiple nails, rounded cross section
856	Poor-quality degraded half log with a nail, perhaps a filler piece

FASTENERS

Artifact No.	Rank	Length*	Width*	Thickness*	Wood Species
645	1	15	8	8	*Pinus* sp.
828	2	17	7	1	*Pinus* sp.
1028	2	17	5	4	*Taxodiaceae*
1297	2	11	3	3	*Pinus* sp.
1433	1	20	5.8	3.5	*Cunninghamia lanceolata*
1677	2	16	7	3	*Cinnamomum camphora*
1678	2	12.5	6	1.8	*Cunninghamia lanceolata*
1811-c	2	5.5	3	3	*Pinus* sp.

*All measurements are in centimeters.

Brief Descriptions (Fasteners)

645	Peg? wood joinery from Korea? cut marks
828	Complex wood joinery
1028	Wooden plug?
1297	Peg? wood joinery from Korea?
1433	Complex wood joinery with small nails
1677	Peg hole, complex wood joinery
1678	Complex wood joinery with a small nail
1811-c	Peg? treenail?

MISCELLANEOUS COMPONENTS

Artifact No.	Rank	Length*	Width*	Thickness*	Wood Species
193	2	130	31	16	*Cinnamomum camphora*
213	2	26	10	8	*Cinnamomum camphora*
215	4	25	3.5	NA	*Prunus* sp.
216	4	21	4.5	NA	NA
307	2	176	18	8	*Cinnamomum camphora*
601	2	300	48	16	*Cinnamomum camphora*
627	2	23	10	5.5	*Erythrophloeum* sp.
642	2	101	26	13	*Cinnamomum camphora*
669	2	40	24	9	*Cinnamomum camphora*
672	1	27	9	3	*Castanopsis* sp.
679	2	60	25	10	*Pinus* sp.
742	5	43	18	6	*Cinnamomum camphora*
749	4	44	13	NA	*Symplocos*
750	4	49	9	NA	*Pinus* sp.
843	3	62	23	10	*Cinnamomum camphora*
851	1	28.2	17.5	6.8	*Cupressaceae*
887	3	38	8.5	12	*Cinnamomum camphora*
951	2	12.5	10	4	*Ulmus* sp.
980	2	NA	NA	NA	*Ulmus* sp.
1007	3	32	13	7	*Cinnamomum camphora*
1056	2	89	13.5	9	*Castanopsis* sp.
1057	5	23.5	10	6	*Cinnamomum camphora*
1078	2	89	4	NA	*Taxodiaceae*
1121	1	NA	NA	NA	*Taxodiaceae*
1184	2	46	10	3.5	*Cunninghamia lanceolata*
1236	1	46	15	12	*Cinnamomum camphora*
1325	4	14	5	4.5	*Pinus* sp.
1342	3	35	NA	NA	*Pinus* sp.
1347	1	84	4	4	*Cotlelobium* sp.
1349	4	33	5.5	3.5	*Cunninghamia lanceolata*
1378	3	76	13	19	*Pinus* sp.
1434	3	100	22	22	*Pinus* sp.
1445	2	56	8	4	*Ulmus* sp.
1447	2	125	8	8	*Taxodiaceae*
1469	2	115	16	9	*Cinnamomum camphora*
1476	1	262	37	15	*Castanopsis* sp.
1505	3	18	9	8	*Ulmus* sp.
1607	1	87	16	2	*Pinus* sp.
1614	2	108	31	25	*Pinus* sp.

MISCELLANEOUS COMPONENTS (continued)

Artifact No.	Rank	Length*	Width*	Thickness*	Wood Species
1648	1	30	5.2	4	*Cunninghamia lanceolata*
1650	4	55	NA	NA	*Pinus* sp.
1718	2	49	3.5	2	*Cunninghamia lanceolata*
1762	2	28	8.5	5.5	*Ulmus* sp.
1861	2	225	16	16	*Ormosia* sp.
1863	1	187	38	13	*Castanopsis* sp.
1871	2	31	9	7	*Pinus* sp.
1875	4	26	9	7	*Pinus* sp.
1346	3	26	13	5	*Cunninghamia lanceolata*
1355	2	95	7.5	5	*Cinnamomum camphora*
1030-b	1	39	5.5	4.5	*Castanopsis* sp.
2003-3	3	33	6	5	*Pinus* sp.
2004-26	2	170	40	10	*Lauraceae*
2004-30	4	OT		4	*Cinnamomum camphora*

*All measurements are in centimeters.

Brief Descriptions (Miscellaneous Components)

193	Degraded, poorly constructed mast step
213	Possible filling piece made for a specific purpose, small timber with several nails
215	Small fragment of bamboo
216	Small fragment of bamboo
307	Well-preserved but charred windlass stand
601	3 m long timber, with a large rectangular opening and several concretions attached
627	Charred, rectangular block of wood
642	Block of shaped timber with a rectangular opening, with large nails or bolts
669	Block of cut wood, neatly shaped in rectangular shape, without a nail
672	Charred curved wood, a possible decorative feature of a ship?
679	Large wood with only small nails, part of a large component
742	Highly degraded timber with several nails
749	Highly degraded blocky wood without any feature
750	Heavily degraded, but might have had carved joinery, might be a curved timber
843	Broken segment of a larger timber, with two large nails attached
851	Block of wood in original shape, neatly shaped with concave cross section, charred
887	Appears to be a scarf (triangular shape from side), with two nails

Brief Descriptions (Miscellaneous Components) (continued)

951	Degraded timber with many nails, originally one piece with Artifact No. 1762
980	Possible rigging element?
1007	Appears to be a filling piece held down by several nails
1056	Possible floor timber or part of bulkhead?
1057	Highly degraded possible filling piece, multiple nails
1078	Long branch-like timber, but with several small nails
1121	Rounded flat-shaped timber, possible plug for a container
1184	Possible small equipment, perhaps a rigging element?
1236	Possible frame or futtock, perhaps a large filling piece like deadwood
1325	Possible filling piece with a trapezoidal cross section
1342	Degraded timber, but seems to show carved joinery at one end
1347	Long, rounded, and well-preserved timber, a spear or a rod
1349	Highly degraded, but could have been a frame or bottommost bulkhead
1378	Small section of a scarf or step of plank or bulkhead
1434	Highly degraded timber, a possible mast step? a rectangular hole similar to Artifact No. 642
1445	Slender timber with rectangular hole and a rectangular notch, possible part of equipment
1447	Long thin timber with numerous nails, used as a weapon or defense for a vessel
1469	Possible frame, or naturally curved timber
1476	Large frame, a bulkhead support timber or a futtock
1505	Possible section of a larger timber? or filling piece
1607	Flat plank with corrosion at the outer edges, perhaps a bulkhead support
1614	Appears to be a split tree trunk, function unknown
1648	Timber in original shape, two nails, function unknown
1650	Highly degraded broken timber with a trace of carved joinery
1718	Thin and slender wood, almost appears to be firewood, but has a nail
1762	Function unknown, broken half of Artifact No. 951
1861	Possible rudder stem, with two rectangular openings, charred
1863	Thick plank-like timber, with nails, triangular recess, and other unique joinery
1871	Small timber with a rectangular opening (not going through)
1875	Possible filler piece with many nails
1346	Railing-like timber with unknown function, similar to Artifact Nos. 951 and 1629
1355	Possible frame of below-deck planking, multiple nails as evidence of repair?

Brief Descriptions (Miscellaneous Components) (continued)

1030-b	Small curved timber, well shaped, with nails, function unknown
2003-3	Timber with multiple nails, function unknown, but appears to be from a small object
2004-26	Most likely a floor timber of a round-hull/flat-bottom vessel
2004-30	Degraded timber, with possible nails

LOGS

Artifact No.	Rank	Length*	Width*	Thickness*	Wood Species
305	3	37	5	NA	*Pinus* sp.
306	3	28	7	NA	*Pinus* sp.
361	2	118	8	8	*Pinus* sp.
632	3	77	6.5	6.5	*Pinus* sp.
636	5	44.5	8	NA	*Castanopsis* sp.
678	3	166	8	NA	*Castanopsis* sp.
854	2	69	7	7.5	*Dalbelgia* sp.
865	1	55.5	8	7	*Ulmus* sp.
880	5	50+	NA	NA	*Pinus* sp.
884	3	77	12	9.3	*Ulmus* sp.
990	3	91	10	10	*Pinus* sp.
1002	4	NA	NA	NA	*Quercus (Cerris)*
1004	5	21	NA	NA	*Pinus* sp.
1024	3	NA	NA	NA	*Ulmus* sp.
1045	4	29	6	NA	*Ulmus* sp.
1046	5	NA	NA	NA	*Sapindus mukorossi*
1079	1	53	2	NA	*Cupressaceae*
1095	4	33	10	NA	*Ulmus* sp.
1099	4	22	7	NA	*Pinus* sp.
1106	5	50+	NA	NA	*Pinus* sp.
1116	4	37.2	4.5	NA	*Pinus* sp.
1127	4	NA	9	NA	*Pinus* sp.
1161	4	40	4	NA	*Pinus* sp.
1299	5	NA	NA	NA	*Pinus* sp.
1314	4	103	6.5	6.5	*Pinus* sp.
1337	4	30	3	3	*Ulmus* sp.
1366	4	40	3.5	NA	*Pinus* sp.
1368	5	50+	NA	NA	*Pinus* sp.
1397	4	49	15	6	*Pinus* sp.
1398	4	22	5	NA	*Pinus* sp.
1402	4	NA	NA	NA	*Pinus* sp.

LOGS (continued)

Artifact No.	Rank	Length*	Width*	Thickness*	Wood Species
1479	5	NA	4	NA	*Dalbelgia* sp.
1629	5	50+	NA	NA	*Prunus* sp.
1634	1	130	10	10	*Pinus* sp.
1734	1	55	5	4	*Pinus* sp.
1497-a	4	50+	NA	NA	*Pinus* sp.
1497-b	4	NA	NA	NA	*Pinus* sp.
865 fragment	5	NA	NA	NA	*Cunninghamia lanceolata*
2003-2	2	174	7	5	*Pinus* sp.
2003-49	4	16	4	3	*Pinus* sp.

*All measurements are in centimeters.

CUT LOGS

Artifact No.	Rank	Length*	Width*	Thickness*	Wood Species
681	1	70.5	7.5	7.5	*Pinus* sp.
644	1	115	7	NA	*Pinus* sp.
685	2	40.2	4	4	*Podocarpus* sp.
686	4	NA	NA	NA	*Ulmus* sp.
950	3	45	8	NA	*Ulmus* sp.
964	2	49	13	5	*Ulmus* sp.
999	2	55	5.5	5	*Ulmus* sp.
1012	4	50+	NA	NA	*Ulmus* sp.
1059	2	48.5	5	5	*Pinus* sp.
1069	1	221	8	8	*Pinus* sp.
1070	1	165	7	7	*Pinus* sp.
1118	1	51	5.5	5.5	*Pinus* sp.
1156	2	47	4	NA	*Pinus* sp.
1252	4	52	5	NA	*Pinus* sp.
1283	3	50+	3.5	3	*Pinus* sp.
1303	1	73	5.5	5.5	*Pinus* sp.
1311	3	40.5	4	4	*Pinus* sp.
1363	4	34	4.5	NA	*Pinus* sp.
1392	2	41	8	6	*Castanopsis* sp.
1432	3	70	9	8	*Dalbelgia* sp.
1458	5	NA	NA	NA	*Dalbelgia* sp.
1641	2	54	11	11	*Pinus* sp.
1645	3	28	5	5	*Pinus* sp.
1649	4	37	8.5	NA	*Ulmus* sp.

CUT LOGS (continued)

Artifact No.	Rank	Length*	Width*	Thickness*	Wood Species
1683	2	52	4	4	*Pinus* sp.
1691	1	52.5	3.5	3.5	*Pinus* sp.
1769	4	30	5	4.5	*Pinus* sp.
1772	2	47	10	NA	*Pinus* sp.
1776	3	73	5.6	NA	*Pinus* sp.
1805	2	100	4	4	*Pinus* sp.
1812	2	200+	5.5	5.5	*Pinus* sp.
1821	2	29	5.5	5.5	*Cunninghamia lanceolata*
1858	4	78.5	9	9	*Pinus* sp.
1862	1	53	7.5	7.5	*Pinus* sp.
1879	1	57	3.8	NA	*Pinus* sp.
1900	3	64	4	4	*Pinus* sp.
1625-b	2	60	6	6	*Tectona grandis*
864-b	2	52	7.5	8	*Sophora Ulmus* sp.
887 CL	2	40	8	8	*Ulmus* sp.
2004-13b	4	27	6	3	*Castanopsis* sp.

*All measurements are in centimeters.

UNIDENTIFIABLE

Artifact No.	Rank	Length*	Width*	Thickness*	Wood Species
192	3	34	6.5	4	*Dalbelgia* sp.
196	4	NA	NA	NA	*Zizyphus jujube*
222	3	20.5	5	1.5	*Cunninghamia lanceolata*
345	3	34	9	5	*Ulmus* sp.
347	4	18.5	4.8	5.5	*Taxodiaceae*
348	4	28	4.5	NA	*Cryptomeria* sp.
352	4	12	6	2	*Cunninghamia lanceolata*
609	5	NA	NA	NA	*Cunninghamia lanceolata*
611	5	NA	NA	NA	*Cinnamomum camphora*
617	3	28	3.5	2	*Cunninghamia lanceolata*
619	5	29	7.5	5	*Pinus* sp.
635	3	54	10	10	*Pinus* sp.
653	5	19	12	6.5	*Cryptomeria* sp.
658	5	NA	NA	NA	*Pinus* sp.
668	5	NA	NA	NA	*Cinnamomum camphora*
680	5	NA	NA	NA	*Cupressaceae*
683	5	NA	11	NA	*Pinus* sp.
684	3	NA	8	NA	*Pinus* sp.

UNIDENTIFIABLE (continued)

Artifact No.	Rank	Length*	Width*	Thickness*	Wood Species
795	4	NA	NA	NA	*Ilex* sp.
859	5	NA	NA	NA	*Cinnamomum camphora*
860	5	50+	NA	NA	*Cinnamomum camphora*
861	5	50+	NA	NA	*Cinnamomum camphora*
862	5	NA	NA	NA	*Pinus* sp.
866	4	NA	NA	NA	*Cunninghamia lanceolata*
886	5	NA	NA	NA	*Cryptomeria* sp.
888	5	50+	NA	NA	*Ulmus* sp.
990	5	NA	NA	NA	*Pinus* sp.
991	5	50+	NA	NA	*Pinus* sp.
996	4	NA	NA	NA	*Pinus* sp.
997	5	NA	NA	NA	*Taxodiaceae*
998	4	82	8	5	*Cunninghamia lanceolata*
1017	5	NA	NA	NA	*Pinus* sp.
1021	5	19	6	3.5	*Cryptomeria* sp.
1029	4	37	13	NA	*Ulmus* sp.
1047	5	NA	NA	NA	*Cinnamomum camphora*
1048	5	NA	NA	NA	*Cinnamomum camphora*
1055	5	NA	NA	NA	*Cinnamomum camphora*
1062	3	NA	NA	7	*Cinnamomum camphora*
1067	4	NA	3	1	*Cunninghamia lanceolata*
1108	4	22	8	4	*Cinnamomum camphora*
1111	3	19	8	NA	*Cinnamomum camphora*
1112	3	35	4	3	*Cunninghamia lanceolata*
1119	4	26	6	NA	*Pinus* sp.
1129	4	36	4.5	NA	*Cunninghamia lanceolata*
1131	4	27	5	2	*Pinus* sp.
1143	3	NA	6.5	3	*Cinnamomum camphora*
1152	4	NA	NA	3	*Taxodiaceae*
1159	5	NA	NA	NA	*Cinnamomum camphora*
1160	5	NA	NA	NA	*Cinnamomum camphora*
1165	5	NA	NA	NA	NA
1174	5	NA	NA	NA	*Pinus* sp.
1202	5	NA	NA	NA	NA
1216	5	NA	NA	NA	*Cinnamomum camphora*
1217	5	70	4	NA	*Pinus* sp.
1218	5	NA	NA	NA	*Taxodiaceae*
1219	3	NA	NA	NA	*Pinus* sp.
1237	5	NA	NA	NA	*Pinus* sp.

UNIDENTIFIABLE (continued)

Artifact No.	Rank	Length*	Width*	Thickness*	Wood Species
1239	5	NA	NA	NA	NA
1260	3	18	4	2	*Pinus* sp.
1265	4	NA	NA	NA	*Cunninghamia lanceolata*
1269	5	NA	NA	NA	*Pinus* sp.
1270	5	NA	NA	NA	*Pinus* sp.
1276	4	NA	5	1.5	*Cunninghamia lanceolata*
1278	4	24	NA	NA	*Cinnamomum camphora*
1280	4	NA	NA	NA	NA
1284	3	23	7	4	*Terminalia catappa*
1289	5	14	3	NA	*Cunninghamia lanceolata*
1294	3	NA	NA	NA	*Cunninghamia lanceolata*
1295	3	20	10	NA	*Pinus* sp.
1310	4	NA	NA	NA	*Castanopsis* sp.
1312	4	21	6	NA	*Pinus* sp.
1313	4	NA	NA	NA	*Pinus* sp.
1322	5	NA	NA	NA	*Cinnamomum camphora*
1333	4	29	5.5	NA	*Pinus* sp.
1334	5	NA	NA	NA	*Hamamelidaceae*
1338	5	NA	NA	NA	*Terminalia catappa*
1339	5	NA	NA	NA	*Terminalia catappa*
1357	4	12	7.5	4.5	NA
1359	4	40	9	NA	*Pinus* sp.
1371	4	33	5.3	3	*Cunninghamia lanceolata*
1372	5	NA	NA	NA	*Dalbelgia* sp.
1399	5	NA	NA	NA	*Cinnamomum camphora*
1429	5	NA	NA	NA	*Pinus* sp.
1457	4	17	10	NA	*Cinnamomum camphora*
1466	3	40	7	NA	*Cinnamomum camphora*
1491	4	33	9	6	hardwood?
1606	4	NA	NA	NA	NA
1620	3	48	28	NA	*Cinnamomum camphora*
1637	4	NA	NA	3	*Taxodiaceae*
1643	4	48	8	5	*Ulmus* sp.
1700	4	17	5	2	*Cunninghamia lanceolata*
1707	5	50+	NA	NA	*Pinus* sp.
1739	5	NA	NA	NA	*Pinus* sp.
1741	4	NA	NA	NA	*Pinus* sp.
1743	4	NA	NA	2.5	*Pinus* sp.

UNIDENTIFIABLE (continued)

Artifact No.	Rank	Length*	Width*	Thickness*	Wood Species
1744	5	NA	NA	NA	*Ulmus* sp.
1752	5	NA	NA	NA	*Ulmus* sp.
1768	5	NA	NA	NA	*Cinnamomum camphora*
1771	5	NA	NA	NA	*Cunninghamia lanceolata*
1784	5	NA	NA	NA	*Cinnamomum camphora*
1813	3	27	9	2	*Castanopsis* sp.
1845	3	NA	NA	3	*Lauraceae*
1856	3	37	10	NA	*Ulmus* sp.
1035-c	5	NA	NA	NA	*Tsuga* sp.
1035-d	5	NA	NA	NA	*Cunninghamia lanceolata*
1047-b	5	NA	NA	NA	*Cinnamomum camphora*
1047-c	5	NA	NA	NA	*Cinnamomum camphora*
1142-a, d	5	NA	NA	NA	*Cinnamomum camphora*
1811-b	5	NA	NA	NA	*Cinnamomum camphora*
1827	4	30	8.5	4	*Pinus* sp.
2003-4	4	28	8	5	*Cupressaceae*
2003-6	4	61	8	4	*Cupressaceae*
2003-20	4	50	4	4	*Pinus* sp.
2003-22	5	24	5	4	*Taxodiaceae*
2003-41	4	40	7	NA	*Pinus* sp.
2003-42	4	18	5	3	NA
2003-43	5	71	6	2	softwood?
2003-47	4	22	6	NA	*Taxodiaceae*
2004-10b	3	21	10	6	*Cinnamomum camphora*
2004-19	4	39	8	7	*Pinus* sp.
2004-24	4	17	9	2	*Cinnamomum camphora*
2004-27	5	NA	NA	NA	*Cinnamomum camphora*
2004-34	5	25	2	2	*Cunninghamia lanceolata*
2004-38	5	NA	NA	NA	*Cinnamomum camphora*

*All measurements are in centimeters.

FEATURELESS TIMBERS

Artifact No.	Rank	Length*	Width*	Thickness*	Wood Species
197	5	16	1.5	1	*Ulmus* sp.
200	3	15	4	4	*Dalbelgia* sp.
203	4	23	6	6	*Ulmus* sp.
204	5	17	5	4	softwood?
205	5	30	6	9	*Camelia* sp.
208	5	25	4	1	*Pinus* sp.
209	5	18	5	3	*Ulmus* sp.
250	3	32	5	3	*Ulmus* sp.
303	4	40	11	11	*Myrica* sp.
346	4	NA	NA	NA	*Taxodiaceae*
349	4	46	7	4	*Ulmus* sp.
350	5	9	5	3	*Ulmus* sp.
357	4	21	4	2	*Pinus* sp.
358	5	30	4	NA	*Ulmus* sp.
612	5	NA	NA	NA	*Ulmus* sp.
616	4	NA	NA	NA	*Rosaceae*
618	5	NA	NA	NA	*Rosaceae*
629	4	30	6	2	*Quercus (Cerris)*
666	5	NA	NA	NA	*Pinus* sp.
667	5	NA	NA	NA	*Pinus* sp.
670	5	NA	NA	NA	*Distylium* sp.
677	5	NA	NA	NA	*Prunus* sp.
679	5	NA	NA	NA	*Pinus* sp.
747	5	NA	NA	NA	*Pinus* sp.
748	4	50+	20+	NA	*Pinus* sp.
872	5	NA	NA	NA	NA
969	5	NA	NA	NA	*Quercus (Cerris)*
971	5	NA	NA	NA	*Pinus* sp.
973	4	NA	NA	NA	*Ulmus* sp.
985	5	NA	NA	NA	*Pinus* sp.
986	4	NA	NA	NA	*Castanopsis* sp.
1006	4	NA	NA	NA	*Ulmus* sp.
1016	5	NA	NA	NA	*Cinnamomum camphora*
1023	5	NA	NA	NA	*Pinus* sp.
1040	5	NA	NA	NA	*Dalbelgia* sp.
1063	4	36	8	NA	*Ulmus* sp.
1071	5	NA	NA	NA	*Ulmus* sp.
1073	5	NA	NA	NA	NA
1101	4	NA	NA	NA	*Podocarpus* sp.

FEATURELESS TIMBERS (continued)

Artifact No.	Rank	Length*	Width*	Thickness*	Wood Species
1106	5	NA	NA	NA	*Pinus* sp.
1117	4	20	8	2	*Pinus* sp.
1122	5	NA	NA	NA	NA
1128	5	NA	NA	NA	*Pinus* sp.
1134	5	NA	NA	NA	NA
1144	4	NA	NA	NA	*Cinnamomum camphora*
1154	5	NA	NA	NA	*Cinnamomum camphora*
1164	3	17	2	2	*Prunus* sp.
1235	5	NA	NA	NA	*Pinus* sp.
1256	5	NA	NA	NA	NA
1257	5	NA	NA	NA	*Pinus* sp.
1258	5	NA	NA	NA	*Ulmus* sp.
1268	4	NA	NA	NA	*Pinus* sp.
1273	5	NA	NA	NA	*Cinnamomum camphora*
1281	5	NA	NA	NA	*Cinnamomum camphora*
1282	5	NA	NA	NA	*Pinus* sp.
1290	4	40	NA	NA	NA
1292	5	NA	NA	NA	*Pinus* sp.
1293	4	NA	NA	NA	*Ulmus* sp.
1296	4	NA	NA	NA	*Pinus* sp.
1301	4	NA	NA	NA	*Pinus* sp.
1304	5	NA	NA	NA	*Cunninghamia lanceolata*
1305	4	NA	NA	NA	*Ulmus* sp.
1307	5	NA	NA	NA	*Pinus* sp.
1308	5	NA	NA	NA	NA
1309	3	NA	NA	NA	NA
1317	5	NA	NA	NA	*Cinnamomum camphora*
1318	5	NA	NA	NA	*Cinnamomum camphora*
1326	5	NA	NA	NA	*Ulmus* sp.
1327	5	NA	NA	NA	*Ulmus* sp.
1328	4	NA	NA	NA	*Ulmus* sp.
1329	5	NA	NA	NA	*Pinus* sp.
1330	4	NA	NA	NA	*Quercus*
1336	5	NA	NA	NA	NA
1350	5	NA	NA	NA	NA
1351	5	NA	NA	NA	NA
1365	5	NA	NA	NA	*Pinus* sp.?
1367	5	NA	NA	NA	*Cinnamomum camphora*
1376	5	NA	NA	NA	*Ulmus* sp.

FEATURELESS TIMBERS (continued)

Artifact No.	Rank	Length*	Width*	Thickness*	Wood Species
1400	5	NA	NA	NA	*Cinnamomum camphora*
1435	4	NA	NA	NA	*Cryptomeria* sp.
1455	5	NA	NA	NA	*Pinus* sp.
1498	5	NA	NA	NA	*Cryptomeria* sp.
1499	5	NA	NA	NA	*Ulmus* sp.
1630	5	NA	NA	NA	*Pinus* sp.
1631	5	NA	NA	NA	*Dalbelgia* sp.
1682	3	28	NA	NA	*Pinus* sp.
1719	5	NA	NA	NA	NA
1726	5	NA	NA	NA	*Ulmus* sp.
1745	5	NA	NA	NA	*Pinus* sp.
1770	5	NA	NA	NA	*Pinus* sp.
1843	5	NA	NA	NA	*Cunninghamia lanceolata*
1865	4	NA	NA	NA	*Ulmus* sp.
1502-b	5	NA	NA	NA	*Pometia* sp.
679 fragment	5	NA	NA	NA	*Pinus* sp.
885-c	5	NA	NA	NA	*Quercus (Cyclobalanopsis)*
990 fragment	5	NA	NA	NA	*Pinus* sp.
2003-7	5	NA	NA	NA	*Pinus* sp.
2003-12	4	24	6	NA	*Dalbelgia* sp.
2003-18	5	NA	NA	NA	*Pinus* sp.
2003-19	5	NA	NA	NA	*Pinus* sp.
2003-23	5	NA	NA	NA	*Ulmus* sp.
2003-27	5	NA	NA	NA	*Ulmus* sp.
2003-30	5	19	12	2.5	*Quercus serrata*
2003-35	4	48	NA	NA	*Pinus* sp.
2003-38	5	NA	NA	NA	*Quercus (Cyclobalanopsis)*
2003-39	5	12	8	1.5	NA
2003-44	5	16	3.8	0.5	*Quercus (Cyclobalanopsis)*
2004-06	3	36	6	3	*Cunninghamia lanceolata*
2004-13a	4	31	7	4	*Castanopsis* sp.
2004-22	5	NA	NA	NA	NA
2004-40	5	NA	NA	NA	*Pinus* sp.
2004-41	5	NA	NA	NA	*Pinus* sp.

*All measurements are in centimeters.

Notes

PREFACE

1. Saeki 2003.
2. Delgado 2008; Man 2006; and Turnbull 2010.
3. For example, see Matsuura Board of Education 2008.
4. Delgado 2008.

CHAPTER 1

1. Koga 1982.
2. Takashima Board of Education 1984, 1.
3. Mozai 1982.
4. Takashima Board of Education 1984, 1.
5. Rossabi (1998, 154–60) explains that Khubilai ordered Phags-pa lama, a Tibetan monk, to create a script to be used for official documents based on the Tibetan alphabet suitable for the Mongolian language and Chinese phonetics. However, this script did not see wide use.
6. Mozai 1982.
7. Takashima Board of Education 1984, 1.
8. In Japan the Board of Education of a local government usually manages all sites with archaeological potential. The site management is funded by the prefecture or by the national government after the local board of education produces significant results and meets certain criteria.
9. Takashima Board of Education 1984, 2–19.
10. Takashima Board of Education 1996.
11. Takashima Board of Education 1996, 32.
12. Written as Te-tsu-ha-u, but most likely pronounced "Tetsuppou." The exact pronunciation is not certain.

13. See Takashima Board of Education 2003 for detailed results of the excavations.

14. Takashima Board of Education 2004 and 2005.

15. Smaller than 25 cm: 230 timbers (45.82%); 25–50 cm: 110 timbers (21.91%); 50–75 cm: 95 timbers (18.92%); 75–100 cm: 27 timbers (5.38%); 100–150 cm: 20 timbers (3.98%); 150–200 cm: 11 timbers (2.19%); 200 cm or larger: 9 timbers (1.79%).

16. Rank 1: 32 timbers (6.37%); rank 2: 90 timbers (17.93%); rank 3: 78 timbers (15.54%); rank 4: 140 timbers (27.89%); rank 5: 162 timbers (32.27%).

CHAPTER 2

1. Flecker (2000) reports a possible Indian or Arabic vessel with Chinese cargo discovered in southeast Asia, alluding to the strong maritime connection between China and the Indian Ocean.

2. The tribute system obligated smaller surrounding countries to pay tribute to a larger or more powerful entity, in this case the Tang imperial family. Merchants had to accept Chinese overlordship and culture, including the written language and calendar, to be listed as a legitimate trader. This was the official avenue for trade between the countries. See Cheng 1991.

3. Anno 1999, 2–4; Kamei 1986, 4–21.

4. Mori 1972, 4.

5. Roberts 2006, 90–106.

6. Sakuma (1995, 170) points out that the tax revenue from the maritime trade provided 5–10% of the government's income. Though this tax percentage seems small, it represents only the profit garnered by the government. Many people in the coastal areas also profited from mercantile, smuggling, and pirate activities. A similar argument can be found in Lo 1969, 64–9; Shiba 1983, 105–6.

7. Levathes 1997, 42–43; Van Tilburg 1994, 2.

8. Shiba 1983.

9. Man 2006, 20, 30–31.

10. Rossabi 1988, 28.

11. Man 2006, 55.

12. Rossabi 1988, 53, 76.

13. Lo 1969.

14. Rossabi 1988, 82.

15. Saeki 2003, 72.

16. Kamei 1986, 5–7.

17. Mori 1972, 5–11; Sakuma 1995, 173; Shiba 1983, 106.

18. Batten 2006; Saeki 2003, 24–25.

19. A detailed discussion of Hakata as "China Town" is discussed in Batten (2006).

20. Saeki 2003, 57.

21. Saeki 2003, 59.

22. Hatada 1965, 108; Ōta 1997, 17–20. The vessels that were used during the revolt may have been refitted and deployed to be used for the invasion.

23. Saeki 2003, 90.

24. Different sources give different numbers of troops. For example, Rossabi (1998, 102) gives different numbers than Ōta (1997, 48) and Hatada (1965, 111), depending on what original historical sources they consulted.

25. Saeki 2003, 94.

26. Man 2006; Rossabi 1998.

27. Ōta 1997; Saeki 2003.

28. For the detail study of *Hachiman-Gū Dōkun*, see Ono 2007.

29. *Yuan Shi* (元史) was written by Song Lian (宋濂); see Ōta 1997, 6.

30. Schottenhammer 2001, 130–40. The significance of this different approach to precious metals was that the value of copper and brass coin might decline in China while the price was more stable in Japan. See also Yamamura and Kamiki 1983.

31. Kamei 1986, 183–86.

32. Rossabi 1988, 208.

33. Rossabi 1988, 53.

34. Rossabi (1998, 76) mentions that in Mongolian tradition the ruler's ability was judged by the wealth or the land that he controlled. In China the authority of the emperor was reflected by bringing foreigners to accept Chinese cultural and economic supremacy.

35. Hatada 1965, 118.

36. Hatada 1965, 130.

37. Ōta 1997.

38. Saeki 2003, 140; Hatada 1965, 139.

39. Saeki 2003, 142.

40. Hatada 1965, 142.

41. Ōta 1997, 49.

42. Hatada 1965, 142.

43. According to one legend, a woman was hiding in the forest when the

Mongols heard a rooster. They thought someone was hiding inside the forest and thus she was found and killed. To this day, people in this village do not raise chickens.

44. Ōta 1997, 42.
45. Saeki 2003, 148.
46. Ōta 1997, 72–78.
47. Ōta 1997, 72–79.
48. Saeki 2003, 186–87.
49. Saeki 2003, 182.
50. Ōta 1997, 169.
51. Ōta 1997, 169.
52. Hatada 1965, 162.
53. Saeki 2003, 191–92.
54. Sakuma 1995, 196; So 2000, 94.
55. Saeki 2003, 215.
56. Saeki 2003.
57. Totman 2005.

CHAPTER 3

1. Worcester 1971, 335.
2. Needham, Ho, Lu, and Wang 1971, 380.
3. Takashima Board of Education 2003, 63.
4. Lo 1969, 95–96.
5. Ōta 1997, 119–201.
6. The work by Polo can be found in several editions. See Yamagata 2004, 55; Yule 1993, 250–51.
7. The translated works of Battuta can be found in several reprints. See Defremaery and Sanguinetti 1856, 172; Mackintosh-Smith 2002, 223–24; Needham, Ho, Lu, and Wang 1971, 468–70.
8. Lo 1969, 82.
9. *Tai Bai Yin Jie* (太白陰經) was originally written during the Tang dynasty by Li Quan (李荃). See Wang and Zhang 2004.
10. Translation of the name of the vessel is based on terminology by Needham, Ho, Lu, and Wang 1971, 424–25: 楼船 (tower ship), 戦艦 (combat junk), 海鶻 (sea-hawk ship), 蒙衝 (covered swooper), 走舸 (flying barque), 遊艇 (patrol boat).
11. Wang and Zhang 2004, 225–29.

12. Ōta 1997, 62.
13. See Kim 1994.
14. Kim 1994.
15. National Maritime Museum of Korea 2008.
16. Reischauer 1946, 143–44.
17. Worcester 1971, 40.
18. So 2000, 232–33.
19. Worcester 1971, 277–313.
20. Worcester 1971, 384.
21. Worcester 1971, 388, 394–95.
22. Worcester 1971, 434.
23. Mackintosh-Smith 2002, 223–24.
24. *Tian Gong Kai Wu* was originally compiled by Song Yingxing (宋應星), born in 1587. Several publications of the original documents are available. See Yabuuchi 1955.
25. Needham, Ho, Lu, and Wang 1971; Wang 2000.
26. Ihara 2003.
27. Tianjing City Cultural Relics Administration 1983, 58, 67.
28. Tianjing City Cultural Relics Administration 1983.
29. Cultural Relics Bureau of Penglai City 2006, 217.
30. Cultural Relics Bureau of Penglai City 2006, 217.
31. Xi 1999, 209–11.
32. Dun et al. 1994, 20–21.
33. Dun et al. 1994, 25.
34. Xi 1999, 215.
35. Nanjing Municipal Museum 2006.
36. Nanjing Municipal Museum 2006.
37. Lin, Genqi, and Green 1991.
38. Lin, Genqi, and Green 1991, 306–8.
39. Li 1986, 282–83.
40. Wade 2009, 234.
41. Clark 1982, 148.
42. Clark 1982, 147.
43. So 2000, 57.
44. Lo 1969, 79.
45. Yule 1993, 250–51.
46. Zhao 2009.
47. Green, Burningham, and Museum of Overseas Communication History 1998, 282.

48. Green, Burningham, and Museum of Overseas Communication History 1998, 286.

49. Green, Burningham, and Museum of Overseas Communication History 1998, 289–91.

50. Li 1986, 279.

51. National Maritime Museum of Korea (2006b) provides the most complete report of the Shinan shipwreck available in print. Green and Kim (1989, 35) describe stiffeners as "pointed wooden pegs that penetrate each strake from the outside of the hull planking, thus locking the opposite side of the bulkhead to the frames, and are attached to the face of the bulkhead."

52. Rosssabi 1988.

53. Rossabi (1988, 22–24) discusses this campaign in detail.

54. Man 2006, 52–56; Rossabi 1988, 131–52.

55. Rossabi 1988, 92.

56. Approximately 160 km had to be crossed between Korea and mainland Japan.

57. Saeki 2003, 89.

58. See Nahm 1988 and Ōta 1997.

59. Ōta 1997, 14. *Liao* is a unit of measurement for a volume or a weight. One *liao* is approximately 29 liters. Thus, 1,000 *liao* will be approximately 30,000 liters. This is based on the assumption that 1,000 *liao* is a measurement of cargo capacity. Furthermore, 1,000 *liao* seems to be a convenient way to say "cargo ship with great carrying capacity" and not the actual volume of the cargo that the vessel can carry.

60. Yamagata 2004, 48–49.

61. Rossabi 1988, 95–99.

62. Batten 2006, 91–98.

63. Ōta 1997, 49.

64. Nahm 1988, 90.

65. Ōta 1997, 63.

66. Batten 2006, 112–21.

67. Ōta 1997, 76.

68. Ōta (1997), Rossabi (1988), and Saeki (2003) all report different numbers of troops, depending on historical sources and the number of noncombat support personnel.

69. *Yuan Shi* and *Goryeo-sa* mention different numbers of men. One source includes the number of noncombat troops in the total, while the other source mentions the combined number. Furthermore, it is not certain

if these represent the actual or the ideal number of men. See the detailed discussion by Ōta 1997, 48.

70. A possible farming tool has been found at the Takashima underwater site. See Matsuura Board of Education 2008, fig. 58.

CHAPTER 4

1. Takashima Board of Education 2001, 2002, 2003, 2004, 2005. Also see Matsuura Board of Education 2008.
2. Takashima Board of Education 2003.
3. Wade 2009.
4. National Maritime Museum of Korea 2006b.
5. Takashima Board of Education 2003.
6. Hanson 2006.
7. Saeki 2003.
8. Ōta 1997.

CHAPTER 5

1. Steffy 1994, 267.
2. Keith and Buys 1981, 10.
3. Green, Burningham, and Museum of Overseas Communication History 1998.
4. For traditional Korean vessels, consult Kim 1994, 8–82.
5. Worcester (1971) provides excellent drawings of the Chinese traditional vessels.
6. Kim 1994, 13–19, 74, 76.
7. As discussed previously, rank 1 represents a complete timber while rank 5 represents a highly degraded wood fragment.
8. Tianjin City Cultural Relics Administration 1983, 54.
9. Tianjin City Cultural Relics Administration 1983, 54, 57, fig. 6.
10. Tianjin City Cultural Relics Administration 1983, 55, figs. 3 and 7.
11. Kim 1994, fig 26.
12. Kim 1994, 8–13.
13. Office of Cultural Property Management 1985.
14. Office of Cultural Property Management 1984, 135, fig. 6.

15. Yamagata (2004, fig. 3/10) shows a drawing of the Penglai ship with scales; Lin, Genqi, and Green (1991, 306–8) describes the bulkhead and framing structure of the Ningbo ship.

16. Office of Cultural Property Management 1984, 134–35.

17. Waters 1947, 29; 1938, 68.

18. Worcester 1971.

19. Green, Burningham, and Museum of Overseas Communication History (1998, 286) describe the recess cut in the bulkhead.

20. Because all nails found at Takashima were square nails, the dimension of the nails always refers to the one edge of the nail unless otherwise specified.

21. Green, Burningham, and Museum of Overseas Communication History 1998, 286.

22. McGrail 2004, 370.

23. Used the hull lines generated by Green, Burningham, and Museum of Overseas Communication History 1998.

24. Green, Burningham, and Museum of Overseas Communication History 1998, 292.

25. National Maritime Museum of Korea 2006b, 115.

26. Office of Cultural Property Management 1984, 130.

27. McGrail 2004, 372.

28. Herron 1998, 270.

29. For an overview of excavated vessels in China, see Wang 2000 and Xi 1999.

30. Green, Burningham, and Museum of Overseas Communication History 1998, 285. The plank inside the hull was 8 cm, the next layer was 5 cm, and the outer layer had 2.5 cm thick plank.

31. Cultural Relics Bureau of Penglai City 2006.

32. Green, Burningham, and Museum of Overseas Communication History 1998, 285.

33. Waters 1938, 52.

34. Lin, Genqi, and Green 1991, 306.

35. Ni 1979, 33–35.

36. Worcester 1971, 394.

37. Green, Burningham, and Museum of Overseas Communication History 1998, 291. These are small strips of timbers laid along the seam of strakes of the lap joint. The fairing strip thus fits to the "step" made by the overlapping strakes.

38. Ōta (1994, 70–71) describes the historical documents, saying Khubi-

lai made sure that the vessels were well built and repaired for the third invasion. This shows that the use of an old vessel was a common practice.

39. McGrail 2004, 362.

40. Yuan 2006, plate 9.

41. National Maritime Museum of Korea 1999.

42. National Maritime Museum of Korea 2006a.

43. Ōta 1997, 124–30.

44. Green and Kim 1989, 39.

45. Herron 1998, 274.

46. Lin et al. 1991, 309.

47. Xi 1999.

48. Lin, Genqi, and Green 1991.

49. Lovegrove 1932, 252.

50. National Maritime Museum of Korea 2006b.

51. Worcester 1971, 41, 74.

52. Batten (2006, 83) mentions the use of fire as a means for Korean pirates to communicate when at sea.

53. Ōba 2001, 1.

54. Donnelly (1923, 228), Waters (1938, 51; 1939, 72), and Worcester (1971) describe the use of grown timber and small pieces of wood for building a typical Chinese vessel.

CHAPTER 6

1. Donnelly 1923, 228.

2. Cultural Relics Bureau of Penglai City 2006, 100.

3. Green and Kim 1989, 38.

4. Green, Burningham, and Museum of Overseas Communication History 1998, 281.

5. Cultural Relics Bureau of Penglai City 2006, 100.

6. Green, Burningham, and Museum of Overseas Communication History 1998, 281.

7. Lin, Genqi, and Green 1991, 308–9.

8. Yamagata 2004, plate 6/12.

9. Worcester (1971, 97) argues that the larger proportion of the rudder acts as a keel to keep the vessel to the wind.

10. Nanjing Municipal Museum 2006, 114.

11. Worcester 1971.

12. Yamagata 2004, 88.

13. Takashima Board of Education 2001, 4–41.

14. The timber has been identified as camphor tree (*Cinnamomum camphor*). The camphor tree can be found in southern China, Japan, Taiwan, and Vietnam. In Korea the wood grows only on Cheju Island. The wood species analysis will be discussed in detail in chapter 7.

15. Takashima Board of Education 2001, 42–47.

16. Kim 1994, 41–44.

17. The date was given as 864±18 BP. For detailed results of the C-14 dates, consult Takashima Board of Education 2001, 51.

CHAPTER 7

1. The results can be found in Matsuura Board of Education 2008.
2. Needham, Ho, Lu, and Wang 1971.
3. Xi 1999, 179.
4. Worcester 1971, 35.
5. National Maritime Museum of Korea 2006b.
6. Worcester 1971, 35.
7. Xi 1999.
8. Nanjing Municipal Museum 2006.

CHAPTER 8

1. Li 1986, 279.
2. Green and Kim 1989, 35.
3. Office of Cultural Property Management 1984, plate 21.
4. Lin, Genqi, and Green 1991, 302.
5. McGrail 2004, 372.
6. Worcester 1971, 173, 316.
7. Donnelly 1936, 414.
8. Fitzgerald 1943, 137.
9. Yuan 2006, plates 9–11.
10. Kim 1994, 76.
11. Kim 1994, plate 27.
12. National Maritime Museum of Korea 2006a.
13. Kim 1994, 57–82.

14. Worcester 1971, 160, 222.

15. Waters 1947, 31.

16. Monden 2006.

17. Amino 1992, 163.

18. National Maritime Museum of Korea 1999, 2005, and 2006a.

19. Cultural Relics Bureau of Penglai City 2006.

20. Green, Burningham, and Museum of Overseas Communication History 1998, 294.

21. Li 1986, 279–82.

22. Tianjin City Cultural Relics Administration 1983.

23. Yamagata 2004, 55; Yule 1993, 250–51.

24. Li (1986, 279) notes that "no nails were left behind" without the use of putty.

25. Cultural Relics Bureau of Penglai City 2006.

26. Monden 2006.

27. A conservator at the National Maritime Museum of Korea at Mokpo mentioned that the dovetail on the keel as well as the bulkhead were used to align the planks before securing with iron nails; however, this theory is not rigorously discussed.

28. Waters 1939, 67.

29. Barker 1996, 31.

30. Matsuura Board of Education 2008.

CHAPTER 9

1. Conlan 2001.

2. Ōta 1997.

3. See Ōta 1997, 6.

4. Hatada 1965, 118.

5. In fact, all excavated vessels from medieval China had the mast step abutted to the bulkhead.

6. Worcester 1971, 282.

7. Xi 1999.

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